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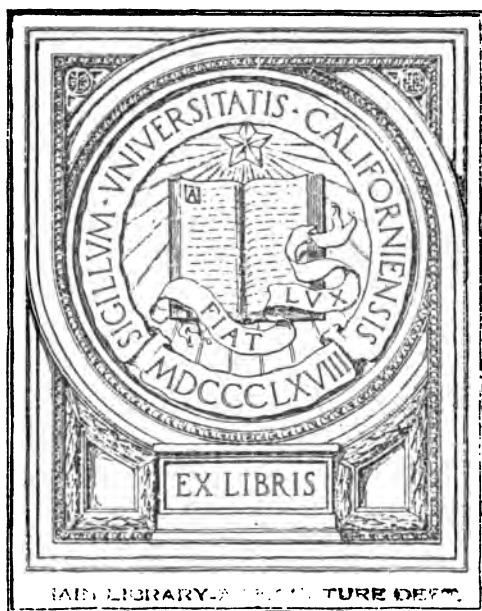
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JUNIOR HIGH SCHOOL SERIES

INTRODUCTION
TO
AGRICULTURE

WEED AND RILEY

DAVEY & COMPANY



JUNIOR HIGH SCHOOL SERIES

INTRODUCTION TO AGRICULTURE

PRACTICAL STUDIES IN
CROP PRODUCTION

BY
CLARENCE M. WEED

AND

WILLIAM E. RILEY

STATE NORMAL SCHOOL, LOWELL, MASS.

D. C. HEATH & CO., PUBLISHERS

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PREFACE

THE art of agriculture is based upon the production of crops. Consequently, it seems highly desirable that the study of agriculture should be begun by a general survey of the field of crop production. By such a survey the student acquires a general knowledge of the many kinds of crops grown in America. He is thus able to supplement by a broader view the knowledge gained in the comparatively narrow field of personal experience.

In this book the attempt has been made to carry out consistently a method of teaching which has led to successful results through many years of use. It is a combination of the laboratory and the project methods in which personal experience with real objects precedes the study of each crop considered. So far as possible these laboratory and project outlines are made so simple that they can be carried on in connection with any school. While the book is especially intended to meet the needs of the Junior High School, it should also prove serviceable in other schools.

The book furnishes the teacher with an abundant series of simple directions for work for each pupil to follow out before taking up the study of the text. The latter gives the most essential facts concerning the characteristics, history, culture, varieties, and enemies of practically all our crops. There are in addition many charts which show the total production of the various crops in the world as a whole, as well as the production in the United States and in special states.

In nearly all cases more outlines are given than are necessary for an adequate study of the text, hence the teacher

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need not feel that it is essential that every set of directions should be carefully followed. There is, however, so little duplication that all of the directions may be followed without detriment to the pupil. The work should be especially valuable in connection with those schools that are carrying out project methods with the home or school garden.

The book is divided into five main parts treating respectively Vegetable Crops, Flower Crops, Fruit Crops, Farm Crops, and the Soil, its Origin and Improvement. It is by no means necessary that this order should be followed. The topics can readily be taken up in any other sequence, but our experience indicates that the order here given is likely to yield the most successful results and to fit in best with the calendar of the school year. An exception may well be made, however, in connection with the soil, and lessons on this subject may be taken up at various times in connection with some of the crops.

The authors' desire is to place especial emphasis upon the importance of having the pupils get a foundation of personal observation in connection with each crop before they study the text. By so doing, they come to the latter with knowledge and experience which enables them to visualize the discussion instead of merely learning so many words and phrases. In this respect the book differs from most others and it is believed that for this reason it will yield more successful results in real knowledge than is the case where the pupil simply goes through a few observations as a supplement to the lessons studied.

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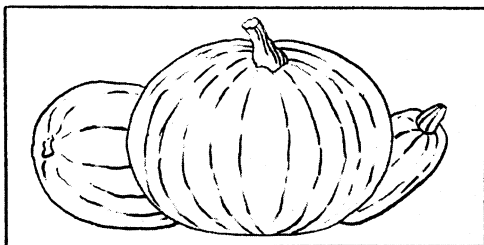
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I
VEGETABLE CROPS



A BOOK OF VEGETABLES





ROOT CROPS: RADISHES, TURNIPS, AND RUTABAGAS

THE RADISH

Germination Test

Twenty-five or fifty radish seeds for each pupil.

If practicable, let each pupil get the seeds from seed-pods in school or home garden.

Place in the germinating box or plate. Examine daily. Remove those that sprout, making a careful record each day.

At the end of a week determine the percentage of germination.

Leave some seeds in a germinating dish until they develop root-hairs, as in the picture above.

Growing Radishes

Fifty radish seeds for each pupil. Choose early round varieties.

A. Outdoors

Plant the seeds half an inch apart in rich mellow soil. Cover one-half inch deep.

4. RADISH CROP PRODUCTION

Watch for the seedlings to come up. Dig up one when the first true leaves appear. Draw on paper or blackboard.

Dig up another three weeks after sowing. Draw the root.

Pull as fast as the roots are large enough to eat.

Compare crispness of different radishes.

B. *Indoors*

Plant in a window box next the window all the seeds for which there is room.

Watch and draw as in A.

Forms of Radishes

Different varieties of radish roots from garden or market, or pictures of the various types as shown in the seed catalogues.

Practice drawing on blackboard or paper the outlines of these types of radish roots:

Round or turnip-shaped

Olive-shaped

Long

Radish Maggots

Radishes growing outdoors. Cut open radishes of any age, even those that have gone to seed. Find brownish tunnels where white maggots have eaten the roots.

Examine several young radishes to see if you can find the maggots at work.

Read the life story of the radish maggot in *Farm Friends and Farm Foes*, pages 126-128.

THE TURNIP AND THE RUTABAGA

Types of Structure

A flat turnip, a round turnip, and a rutabaga, all with leaves if possible. If any types are missing, replace with pictures from seed catalogues.

Make drawings on blackboard or paper of each type of structure.

Notice which types have hairs upon the leaves.

Germination Test

Twenty turnip seeds for each pupil.

Place in germinating box or plate. Examine daily. Record and remove those that sprout.

At the end of a week determine the percentage of germination.

Growing Seedlings

One hundred seeds. A window box filled with garden soil.

Scatter the seeds over the soil of the window box. Cover lightly with fine soil. Water through cheese-cloth.

When the seedlings have three leaves dig up carefully. See:

The roots and root-hairs with soil particles clinging to them.

The stem above the roots.

The seed-leaves.

The true or foliage leaves.

Practice drawing the seedlings on blackboard and on paper.

ROOT CROPS

THE RADISH

Radishes are justly esteemed as valuable roots for eating. They are easy to grow and mature in so short a time that many crops may be taken off the same land in a single season. They require cool weather for their best development, so in most regions they are grown in spring and autumn more than in summer.

There are three principal forms of Radish roots, namely: the Round or Turnip-shaped; the Oval or Olive-shaped; the Conical-cylindrical or Long radishes. The chief colors are red or white or a combination of the two.

Radishes thrive in rich moist loamy soil and are grown in enormous quantities in practically all market garden regions. Winter crops are forced in greenhouses. Good varieties mature in a month or less under favorable conditions, the seed being generally sown in drills ten to sixteen inches apart. The smallest seeds should be discarded, as much better plants are produced by large seeds. In addition to the ordinary spring radishes generally grown in America, there are varieties especially adapted for summer use and others for growing in autumn to store for winter use.

It is not known whether the Radish was developed from an original wild plant that cannot now be found or from the common weed called wild charlock. As

an experiment, edible radishes have been developed from this charlock. So it seems probable that it is the plant from which the radish came.

The most troublesome enemy of the radish is the Radish Maggot. This is one of the root maggots that ruins the roots for food. Eggs are laid by a two-winged fly about the base of the young plant. These soon hatch into larvae that feed upon the thickened root, burrowing through it in all directions. After a few weeks they become full grown as larvae and change to pupae, to change again soon into two-winged flies. A heavy mulching of unleached wood ashes or refuse tobacco powder over the rows just after sowing is said to be a good remedy for the pest. The earliest crop of radishes is seldom infested. A good way to save a later crop would be to start it under gauze-covered frames, as recommended for starting cabbage plants, taking the covers off when the crop is half grown. Frequent rotation of the radish bed is desirable.

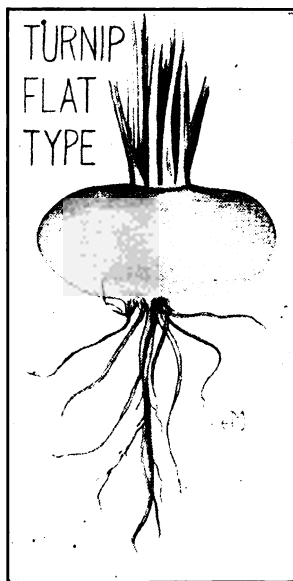
THE TURNIP AND THE RUTABAGA

The origin of the Turnip is not known. It is believed to have been first cultivated in Europe or Asia. It belongs to the great mustard family. The thickened roots are used as a culinary vegetable as well as for stock feed. Two common types of turnips are grown, the Flat and the Globular. The flesh is white or yellow.

Like the radish, the Turnip is a cool season crop, doing best in early spring or late summer and autumn. It requires a rich moist soil and is grown either in drills or broadcast. The chief enemy is the root maggot, to prevent which crop rotation is necessary.

The Rutabaga, or Swedish Turnip, is recognized as a species distinct from the ordinary turnip. While turnip leaves are hairy, those of the rutabaga are smooth and glaucous. The top of the swollen tuber is lengthened into a sort of neck and the lower surface sends out many roots in addition to the long tap-root. The flesh is yellow and generally richer than that of the turnip.

The Rutabaga requires a rich soil and a rather long season. The seed is sown in June for autumn harvesting. In addition to its use as a culinary vegetable it is used largely for feeding cattle.





ROOT CROPS: BEETS, CARROTS, AND PARSNIPS

THE CARROT

Types of Structure

A long, a half-long, and a short or round carrot. If any types are missing supply with pictures from seed catalogues.

Practice drawing on blackboard and on paper until pupils can draw each type from memory.

Germination Test

Twenty carrot seeds for each pupil.

Place in germinating box or plate. Examine daily. Record germination and compute percentage.

Compare time of germination for carrot seeds with time of germination for radish seeds.

Growing in the Garden

Sow a row of carrot seed in early spring in the school garden.

At the same time plant several carrots that have been kept over winter. Be sure the crown bud at the top is not injured.

Give good tillage and care. Thin the seedlings to two inches apart.

See that the seedlings develop roots by autumn and that the roots from last year's growth develop flowers and seeds.

This sort of a plant is called a *biennial*, because it takes two years to produce seed.

BEETS AND MANGELS

Seed Structure

Twenty beet seeds for each pupil.

Place in germinating box or plate. When germination begins examine the seed under a hand lens. Find the exact number of plants starting from one seed.

Examine many seeds to see if they are really seeds or a sort of seed-pod, each holding two or more seeds.

Growing in the Garden

Sow seeds and plant beet roots as directed above for the carrot, to show that the beet also is a biennial.

THE PARSNIP

Germination Test

Twenty parsnip seeds for each pupil.

Place in germinating box or plate with carrot seeds. Examine daily. Record germination and compute percentage.

Compare time of germination of parsnip seeds with the time of germination for carrot seeds.

THE WILD PARSNIP

Pull up a wild parsnip. Compare its root with the root of the cultivated parsnip.

Examine the seed. Find the use of the wing.



ROOT CROPS (*Continued*)

THE BEET

The various forms of Beets now cultivated have been derived from the Wild Beet, which is common in Southern Europe and other regions bordering the Mediterranean sea. In addition to the Garden Beet, with which we are now especially concerned, there are the large, coarse-grained Mangel Wurzels or Mangels, grown for stock feed; the Sugar Beets, grown for their sugar content; the Foliage Beets, grown for ornament; and the Swiss Chard, grown as a pot-herb.

It is believed that all of these have been derived from the original Wild Beet. This shows what can be done by selecting seed with reference to different characters of the plant.

The varieties of Garden Beets are divided into four classes as to form, namely: Top-shaped or Turnip-rooted, Oval, Half-long, and Long. The Turnip-shaped sorts, however, are the ones now grown chiefly for use as a culinary vegetable. They require a rich, deep, moist soil in good tillage, and under favorable conditions will become large enough for bunching in eight weeks from seeding. They are usually planted very early in spring for summer use, and again in summer for fall and winter use.

The so-called seed of the Beet is really a seed-head or fruit, in each of which there are usually several seeds.

Because of this it is necessary to thin the seedlings even if the seed is scattered sparsely in the drill. The seedlings thinned out are commonly saved for beet-greens. Early in the season the beets are sold in bunches; later by the bushel. Three hundred bushels per acre is a fair yield.

THE CARROT

The great family of plants which have small flowers grouped together in flat-topped clusters or umbels is called Umbelliferae. It includes three well-known vegetables, two of which — carrot and parsnip — are cultivated for their roots, and one — parsley — for its leaves and leaf-stems. All are hardy species and from the point of view of seed production are biennials.

The cultivated Carrot is believed to have been developed at least two thousand years ago, from the Wild Carrot, a familar weed called by botanists *Daucus carota*. Its original home was probably Europe or Asia. The Carrot is now an indispensable vegetable for use in soups, stews, and salads, as well as for table use alone and for feeding stock.

The original long Carrot has been developed through selection into three distinct forms as to length — Short or Globular, Half-long, and Long. The two latter have also two types of pointedness, one set of varieties being distinctly pointed at the lower end and the other set blunt or rounded. There are also four types of color in the roots — white, yellow-red or orange-red and purple. The yellow and the orange-red types are the most popular.

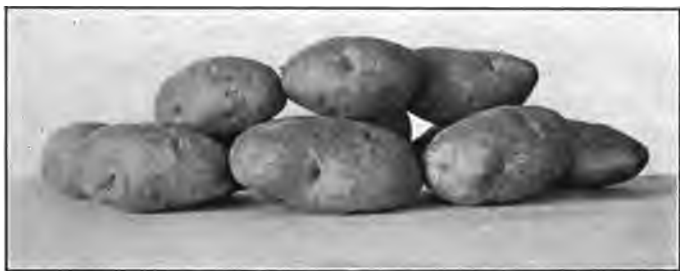
The main crop of Carrots requires a long season for

growth. With most sorts the seed is sown early in spring and the roots are harvested late in autumn, but quick-growing forcing varieties that become large enough for use in early summer are now available. The Carrot thrives in a rich, deep, moist soil in the best condition that tillage can give it and as free as possible from weeds. The seeds are slow in germinating, so it is well to mark the rows by adding a few radish seeds. The seeds are commonly planted in drills twelve to sixteen inches apart for hand hoeing. The seedlings must be weeded and thinned so that each root will have plenty of room. Two hundred bushels to the acre is a fair yield.

THE PARSNIP

Like the carrot the Parsnip is believed to have been developed more than two thousand years ago from a wild plant — the Wild Parsnip, which is a common weed along many roadsides. There are three types of roots — the Short or Globular, the Half-long, and the Long.

The Parsnip requires a soil even deeper than that for the carrot, as the slender tap-root of the long variety has been traced down nearly three feet. The soil should be rich and moist and in fine tilth. Seeds are planted early in spring in drills fifteen to eighteen inches apart and the seedlings thinned to four or five inches apart. The seeds germinate slowly, so the rows should be marked by radish seedlings. The roots mature late in autumn and may be dug then or left in the ground through the winter, if protected by a light mulch. Five hundred bushels to the acre is a good yield.



TUBER CROPS: THE POTATO

TYPES OF FORM

Potatoes showing variety of form — long, round, and intermediate. Make outline or shaded drawings on blackboard or paper.

Depth of Eyes

Potatoes of various forms, some with deep, some with shallow eyes.

Weigh a potato with shallow eyes. Make a record of its weight. Peel this potato. Weigh the peelings. Determine the per cent of peelings.

Weigh a potato with deep eyes. Make a record of its weight. Peel this potato. Weigh the peelings. Determine the per cent of peelings.

In which potato is there the greater waste by peeling?

Seed Balls

Seed balls from potato tops, brought in by the pupils. Examine carefully and draw. Open and examine.

What do they come from? How do they differ from potato tubers in origin?

Cut the balls in two. Place in water in a dish. In a week or so they will begin to ferment. Then wash out

the seeds and store carefully for planting the next spring. In the spring plant and see the development of new tubers when the vines are dug.

Insect Enemies

Find as many stages of the potato beetles as you can and bring to school.

Do these insects bite the leaves or suck the sap?

Where and in what stage do they pass the winter?

Read pages 135-136, *Farm Friends and Farm Foes*.

Can you find on the leaves tiny black beetles that jump when disturbed? These are flea beetles.

Can you see the little holes in the leaves that these flea beetles make?

How do farmers destroy potato insects? Spray or dust the potato plants in school or home garden with arsenate of lead to prevent injury by these insects.

Are potato leaves sprayed with Bordeaux mixture injured by flea beetles?

Fungous Enemies

Find potato leaves injured by blight. Compare with healthy leaves.

If there are sprayed potato plants near by see the difference between them and unsprayed plants. Spray your own plots with Bordeaux mixture.

Find out if the tubers from blighted plants are more liable to rot than those from healthy plants.

Find some scabby potatoes. Inquire if any one in the neighborhood soaked the seed potatoes in formalin solution. What was the result? A better way to find out is to soak the seed potatoes you plant in formalin solu-

tion. Dilute one-half pint formalin with fifteen gallons of water. Soak two hours.

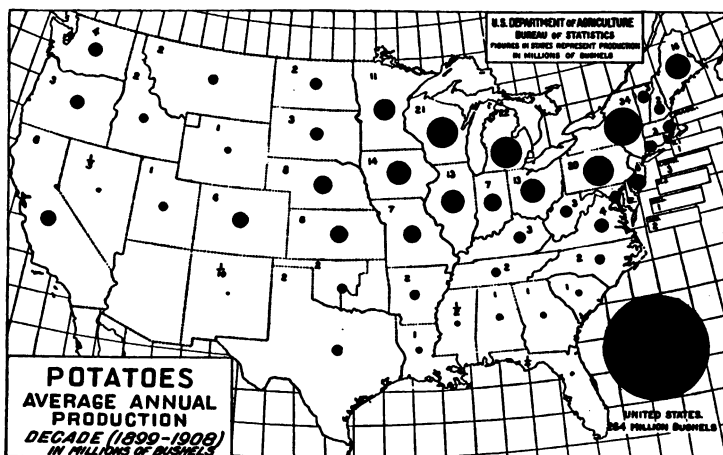
Scoring a Hill of Potatoes

Let each pupil bring to school the total product of one hill of potatoes.

Score each exhibit according to some approved score card, preferably the one in use at your state or county fair. If such is not available use the following:

	<i>Per cent</i>
Name of variety	10
Eight or less tubers, at least two inches in small diameter	20
Uniformity of size, not too large or too small	15
Freeness from dirt, scab, rot, or insect injury	15
Smoothness, with shallow eyes	10
Flesh white and firm, without hollow center	10
Story of how they were grown	10
Drawing of the tubers on the blackboard or paper	10
	<hr/> 100

Let each pupil fill out a fresh score card for each exhibit at least three times, each time on a different day.

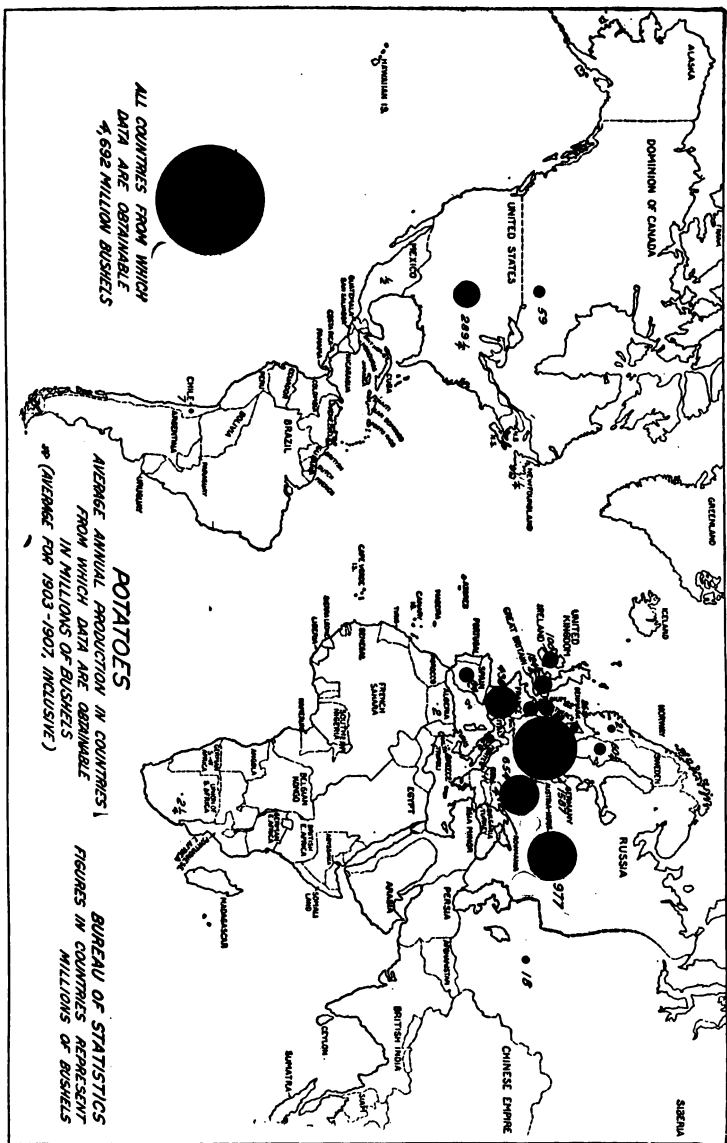


THE POTATO

The Potato is one of the most important crops grown by man. Taking the whole world into consideration it ranks next to rice in extent and value, the world product in a single year amounting to nearly five billion bushels. In America it is by far the most important vegetable crop, and is grown for market as a field staple in many states. New York, Pennsylvania, Michigan, and Wisconsin lead in the production of potatoes, while Maine, Montana, and Nevada lead in the average number of bushels per acre. The average annual crop for the whole United States is estimated at more than two hundred and fifty million bushels.

The cultivated Potato has been derived from a wild plant called *Solanum tuberosum*, which has been growing since prehistoric times in South America and Mexico. The natives of Peru appear to have brought it into cultivation some thousands of years ago, so that when the Spaniards invaded that country in the sixteenth century they found the Potato in cultivation. They were so impressed with its value that tubers were sent to Europe in 1542 and later.

Potatoes were also grown by the early colonists of North America, though whether they were obtained from Indians or Spaniards seems not to be known. A notable date in the history of the Potato is the year 1586, when it was introduced into Ireland. It there became so



important a crop that to this day it is known as the Irish Potato.

While the sweet potato is a root-tuber, the Potato is a stem-tuber, developing from an underground stem or root-stock. The eyes upon the tuber are really buds and



are arranged in spirals in a way that may be readily seen by placing a pin or tack in the eye of each potato and then twisting a piece of string along the line. The tuber is a store house of starchy plant food

POTATOES AS THEY FORM IN THE HILL by means of which the plant is a perennial.

It now rarely reproduces by means of the berry-like fruits that follow the blossoms above ground.

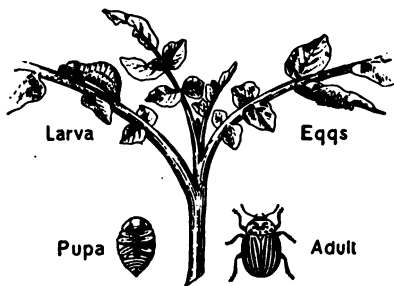
The Points of a Good Potato

For the ordinary purpose of home or market a potato should be of good size, but not so large as to be liable to show hollow spaces when cut open. It should be thick for its length and have few and shallow eyes, that there may be as little waste as possible in peeling. When grown under favorable conditions it should cook to a good mealy quality. Stems and leaves should be held erect and have as much resistance to disease as possible. In most markets a white skinned, white-fleshed potato is preferred to one showing red colors.

Potatoes thrive in a deep, moist soil which is well-drained and loamy, with an abundance of humus or decaying vegetation. The details of culture vary considerably in different regions, but all agree in having the roots so well covered that there is plenty of room for the tubers to mature without exposure to the sun and air.

In regions where potato production is a specialty the culture, planting, spraying, digging, and sorting is done with the help of special machines, but in most regions the work is done by hand. The most successful growers cut the tubers to not more than two or three eyes before planting, the cuttings being placed about a foot apart in rows about three feet apart. The crop requires a complete fertilizer with an abundance of potash. A good average yield is about two hundred bushels per acre, but much greater yields are obtained by scientific cultivation.

In the southern states the production of early tubers for northern markets is one of the most important phases of the great truck crop industry. Northern grown seed of early varieties is planted as early as the climate allows. The new potatoes are packed in slatted barrels with burlap covers and sent by rail to New York or Boston and other northern cities. From these great centers they are distributed to local markets everywhere.



COLORADO POTATO-BEETLE

Insect and Fungous Enemies

Potato leaves are almost universally attacked by the Ten-lined Potato Bug, the most destructive enemy of the crop. The adult beetle appears as soon as the plants come up, feeding upon the young leaves and depositing clusters of yellow eggs. These eggs soon hatch into dark brown larvae that also eat the leaves



POTATO LEAF AFFECTED WITH
LATE BLIGHT

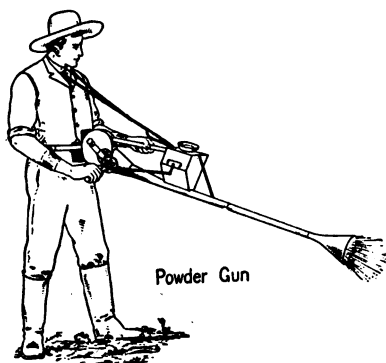
and if undisturbed soon defoliate the plants. The larvae become full-grown in about a month. Then they enter the soil and change to pupae, to change again a little later to the second brood of adult beetles. These lay eggs for the second brood of larvae, which is likely to be much more numerous and destructive than the first. Spraying or dusting the leaves

with arsenate of lead or other arsenical is the general remedy for this pest.

The Leaf Blight or Early Blight of Potatoes is one of the most widespread of diseases. It is due to the attack of a parasitic fungus that develops only in the leaves and stems. About the time the plants blossom the disease begins to show as small grayish or brownish spots scattered over the leaflets. These spots are dry and brittle. They enlarge from day to day as the threads of the fungus invade new cells in the green tissues. Finally many of

them run together to form large brown blotches, so that the plant is killed and the growth of the tubers ceases. The latter do not rot, however, as in the case of those affected by the Late Blight.

In the regions where it occurs the Downy Mildew or Late Blight is the most destructive fungous disease of Potatoes. The fungus attacks both leaves and tubers, causing a serious rotting of the latter. Fortunately it can be prevented to a large extent by spraying with Bordeaux mixture, a treatment that also helps in preventing injury by flea beetles and Early Blight. Arsenate of lead is generally added to the fungicide whenever the potato beetles threaten damage.





BULB CROPS: ONIONS, LEEKS, AND SHALLOTS

THE ONION

Types of Bulb Crops

A collection of as many varieties of onions as teacher and pupils can bring together — large onions, small onions for pickling, bunch onions, and sets. Also chives and leeks if available.

Make outline or shaded drawings on blackboard or paper of round and flat types. Also of groups of sets or small onions.

Origin of Seed

The tops of an onion gone to seed in school garden or some home garden.

Let each pupil pull out some of the black seeds from the withered flowers.

If multiplier onions are available show how these originate.

Seed Germination

Twenty onion seeds for each pupil.

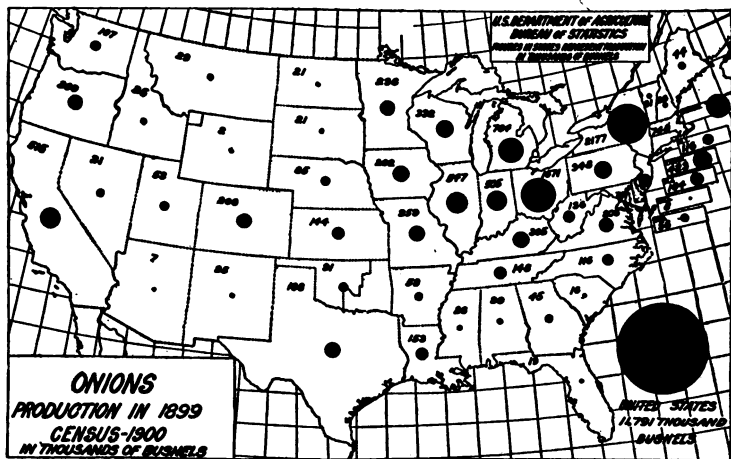
Place in germinating box or plate. Examine daily and determine the per cent of germination.

Growing Seedlings

One hundred or more seeds. A window box filled with garden soil.

Scatter the seeds over the soil. Cover lightly. Water through cheesecloth.

When the seedlings come up, have the pupils examine them carefully and make outline drawings on blackboard or paper.



BULB CROPS

THE ONION

The Onion is by far the most important of the Bulb Crops. Immense quantities are raised commercially for home and export markets and considerable quantities are also raised by individuals for home use. During recent years the production of early Onions for northern use has become a leading phase of the trucking industry in many southern states.

Successful Onion growing requires more care in culture than in the case of most crops. Rich level land free from weed seeds and in the very best condition as to fineness and freedom from stones is necessary for the crop. Early in spring the small black seeds are planted thickly in shallow drills and covered with about one-half inch of soil. The slender seedlings soon come up. When they reach a height of three inches they are thinned to an inch and a half or two inches apart. Then later, when the young bulbs are large enough to eat, they are thinned again if mature Onions are wanted. The plants pulled up can be used and the distance between those left will vary from three to six inches, according to the size of the variety and the conditions of culture.

Frequent and shallow tillage is needed to keep the soil surface free from weeds or a crust, and hand weeding of the rows must be given whenever weeds appear among

the seedlings. Care must be taken not to cover the bulbs with soil. Toward the end of summer the leaves should begin to die down as they ripen off. This process is often hastened by rolling a barrel along the rows to break down the tops. When the leaves are all brown, the bulbs are pulled and left exposed a few days to the drying sun to ripen off. Five hundred bushels to the acre is a good yield for Onions.

While the main Onion crop is grown in the way described, there is a large demand, in both home and market, for bunch onions in spring and early summer. These are partly grown bulbs either from seeds or "sets." Sets are simply dwarfed Onions grown so thickly on poor soil that they crowd one another and ripen off as little bulbs, less than an inch in diameter. They are then pulled and stored until next spring. Planted early, they soon start into growth and in a few weeks yield young Onions for pulling. Instead of sets, seedlings are often grown under glass and transplanted when the ground is fairly warm.

In regions where Onions are grown commercially two fungous diseases are often troublesome — the Mildew and the Smut. The Onion Mildew appears as a grayish velvety mold upon the leaves, many of which soon wilt at the tip in a characteristic way. Millions of spores are soon developed and serve to spread the malady. Damp weather is favorable to the disease.

Onion Smut is entirely different in appearance. It shows on leaves and bulbs as blackish streaks made up of the spores of the fungus. It is able to live over winter in the soil, so that if Onions are again planted the disease is likely to be more destructive. Consequently frequent

OTHER BULB CROPS

rotation is one of the best preventive measures for this disease.

The other Bulb Crops — Leeks, Chives, Shallots, and Garlic — are of comparatively little importance in a commercial way. Chives are very useful for the home garden, the leaves furnishing excellent material for seasoning and salads. Leeks, Shallots, and Garlic are not in general demand in America, except in the larger cities. The appearance of Garlic as placed on the market is shown in the picture below.





COLE CROPS: CABBAGE, CAULIFLOWER, AND KALE

THE CABBAGE

Types

Mounted pictures from seed catalogues of flat and conical varieties, as well as those with crumpled leaves.

Let pupils tell of the kinds of cabbages they have grown or seen.

Seed Germination

Ten seeds for each pupil.

Place in germinating dish and determine the percentage that germinate.

Growing Seedlings

About fifty seeds. Window box of garden soil.

Sow seeds on surface of soil outdoors or in sunny window. Cover lightly. Water through cheesecloth.

When seedlings come up, dig up and study structure. See roots, stem, seed-leaves, and true leaf.

Compare with radish seedling.

Draw for booklet.

Enemies

Find cabbage worms or chrysalids and keep in glass-covered box to rear adult butterflies.

In spring and early summer plants that die are likely to show that roots are destroyed by root maggots.

THE CAULIFLOWER

Structure

A cauliflower and a cabbage, each cut through the center vertically.

Compare the structure of the cabbage and the cauliflower.

Find out who grow cauliflower in your neighborhood.

KALE, KOHLRABI, AND BRUSSELS SPROUTS

Structure

A plant of each or mounted pictures from seed catalogues.

Describe kale. How does it differ from cabbage?

Describe kohlrabi. How does it differ from kale?

Describe a Brussels sprouts plant. How does it differ from cabbage?

COLE CROPS

Under the phrase Cole Crops are commonly included several plants now quite different from one another, but which have all been developed from the Wild Cabbage, a member of the Mustard Family, native to European sea coasts. It is a rather small plant and is very different from any of those which have been derived from it. These include Cabbage, Cauliflower, Kale, Kohlrabi, and Brussels Sprouts.

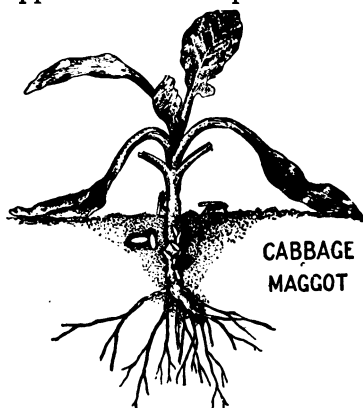
THE CABBAGE

The Cabbage is much the most important of these Cole Crops. It has been grown since prehistoric times and has become a staple article of human food over a large part of the globe. The head is really a shortened stem or giant bud in which in vertical cross-section one can easily see the leaf-stems and leaf-blades, and even the small buds in the axils of the stems. The plant is a biennial, forming heads of leaves the first year and sending up flower stalks the second. There are several distinct types of Cabbages; some have conical heads, others flattened ones. The Savoy Cabbages have crumpled leaves. In each type there are red as well as green or white-leaved sorts.

To mature successfully, Cabbages require a deep, moist, rich, loamy soil in which they can grow continuously until the heads are formed. The young plants are

commonly started in hot-beds or greenhouses for the early crop, and in outdoor seed-beds for the late crop. When started outdoors or when properly hardened off from indoor culture, they are quite hardy as to frost. The small-headed sorts may be planted two feet apart each way, but the large ones require thirty inches or more. After the plants are set, good tillage must be given to save the moisture in the soil, so that there may be no checking of growth. Unless the ground is very rich, the plants will be benefited by one or two light applications of nitrate of soda or other fertilizer rich in nitrogen. Young Cabbages may be planted from late in April until early in July for successive crops.

It is especially important that Cabbage seed be selected from the best plants of each type. Commercial growers appreciate the importance of this and willingly pay



high prices for strains of seed produced by specialists. The difference between profit and loss from a given field may easily depend upon the percentage of plants that make sound heads, and this depends very largely upon the quality of the seed.

Insect Enemies

Two insect pests are often destructive to cabbages — the Root Maggot and the Cabbage Worm. The Root Maggots hatch from eggs laid about the base of the young

plants by a small two-winged fly, somewhat resembling the common house fly. These eggs soon hatch into whitish maggots that feed upon the roots, checking the growth of the seedling, if not killing it outright. In a few weeks the maggots change to pupae, to change later to flies like those that laid the eggs. One of the best ways to prevent such injury is to grow the seedlings in a frame covered with cheesecloth. The cloth is removed a week before the plants are set out to harden off by full exposure to sunshine.

The Cabbage Worm is one of the best known garden insects. The adult is the familiar white butterfly common from spring till fall. These butterflies lay eggs upon the cabbage leaves. The eggs hatch into greenish caterpillars that feed upon the leaves, remaining hidden in the forming head. They feed and grow for several weeks, often riddling the head with their nibbling when several are present. Then, being full grown as caterpillars, they crawl out, and attaching themselves by silken threads to the sides of boards, stones, or other shelter, change to chrysalids, to change again a little later to butterflies. Thus the life-cycle is completed. There are commonly several broods a year. On young plants which have not begun to head, the larvae may be killed by kerosene emulsion. On heading plants insect powder may be used.

Fungous Diseases

There also are two diseases especially injurious to cabbages — Black Rot and Club-root. The Black Rot is a bacterial disease, the germs of which develop by millions in the sap tubes of the plant, causing death and

decay. The destruction of affected plants, rotation of crops, and soaking the seed in a dilute solution of formalin are the most important preventive measures.

Club-root of cabbage is due to a low form of fungus — one of the so-called slime molds — that lives in the

soil and attacks the roots, causing them to become abnormally swollen. Rotation of crops, setting healthy plants, and heavy applications of lime, both to the land and to the seed-bed, are the chief methods of preventing the disease.



THE LATER STAGES OF THE CABBAGE WORM:
LARVA, CHRYSALIS, BUTTERFLY

THE CAULIFLOWER

The Cauliflower is ranked as a variety of the Wild Cabbage, so its technical name is *Brassica oleracea*, variety *botrytis*. The edible part consists of the curiously modified flower clusters which form the succulent white head.

It requires constant and careful selection of seed to keep the type perfect, so that it is more important to use the choicest seed with this crop than with almost any other vegetable. Until recently practically all the seed used in America was grown by specialists in Europe, but

of late excellent seed has been produced in the Puget Sound region. The climate there is especially favorable to the growth of Cauliflowers. The best strains of Cauliflower seed cost five dollars an ounce wholesale, but an ounce will yield more than two thousand plants. Other strains are listed at half this price, but in this case the best is cheapest; because it yields a greater percentage of salable heads.

The Cauliflower is essentially a cool-season crop. In certain regions where the summer climate is cool and moist, the crop can be grown successfully all through the season. Such regions are found near the sea coast or the great lakes or in mountainous localities. In other places where the summer is hot and dry, it is necessary to plan to grow the crop either early or late. For the former the plants are started under glass in February or March, hardened off in early spring, and set out when the ground is in good condition. Such crops mature in early summer and are harvested before the heat and drought of midsummer. For this crop early varieties are planted.

The late crop is started in seed-beds outdoors and planted in June, maturing in early autumn. A chief danger of the summer heat is the burning of the delicate heads, so that the late crop escapes this because the heads are not formed until late in summer or early in autumn. It is desirable, however, to tie up the outer leaves around the heads by means of raffia or bast, thus insuring better blanching and cleaner heads.

Culture and Enemies

It is even more important with Cauliflower than with cabbage that the plants grow steadily and thriftily from beginning to end. To insure this, particular pains must be taken in the selection, preparation, and tillage of the soil. In selecting the location, choose if possible a deep, moist, well-drained loam, rich in humus and easily worked. In preparing the land, work in a large amount of fertilizing material, with plenty of vegetation to furnish humus, and get the soil into the best possible tilth. In tillage, after planting keep the soil surface in so finely pulverized a condition that no weeds can grow and little moisture can evaporate. In regions where irrigation can be practiced throughout the growing season, success with Cauliflower is comparatively easy.

The Cauliflower is subject to attack from the same insect enemies and fungous diseases as the cabbage, and their injuries are likely to be even more disastrous. It is especially important to keep the Cauliflower heads free from worms during the later growth of the crop. The same remedial measures may be used as for cabbage.

KALE, KOHLRABI, AND BRUSSELS SPROUTS

Of all the forms derived from the Wild Cabbage, the Kale or Borecole is most like the original plant. It forms no head, being grown for its clusters of leaves, which are more or less thickened, especially in midrib and stalk, and in modern varieties are of various colors and much cut, curled, and crumpled along the margins. There are dwarf and tall, plain and variegated, green

and purple types. Kale is probably the hardiest plant of the cabbage group, enduring exposure through southern winters and even at the north surviving with slight protection. Large quantities are grown in Virginia, harvested in early winter, and shipped to northern markets.

In the Kohlrabi the edible part is the curiously swollen stem just above the ground. This is sometimes called the Turnip-rooted Cabbage, but this is not a correct name, because the swollen part is not the root at all. Commercially this is one of the least important plants of the cabbage group. The culture is much the same as for cabbage, it being important to harvest the crop before the swollen stems become tough and woody.

In studying the cabbage we learned that there are buds in the axils of the leaves. In the Brussels Sprouts we have a form in which these buds are developed into tiny cabbage heads which are very good to eat. Seed is planted and seedlings transplanted much as with the cabbage. The central stem elongates and sends out coarse leaves along its sides. In summer the buds develop in the axils of the leaves, and the leaves are then to be removed in order that the strength of the plant may be sent into the buds. These increase rapidly in size, looking like miniature cabbages strung upon the stem. A lot of these as they are marketed are pictured on page 29.

	{ Cabbage	<i>Brassica oleracea</i> , variety <i>capitata</i> .
Wild Cabbage	{ Cauliflower	" " " <i>botrytis</i> .
	{ Kale	" " " <i>acephala</i> .
<i>Brassica oleracea</i>	{ Kohlrabi	" " " <i>caulo-rapa</i> .
	{ Brussels Sprouts	" " " <i>gemmifera</i> .



POT-HERB CROPS: SPINACH, CHARD, AND DANDELION

SPINACH

Seed Testing

Twenty seeds for each pupil.

Determine the percentage of germination. If old seeds are available test those also and compare germination with that of fresh seeds.

Leaf Miners

Find spinach leaves with discolored blotches. Hold them to the light to see the maggots inside.

SWISS CHARD

Seed Testing

Ten seeds for each pupil.

Place in germinating dish. When seeds sprout, see if there is more than one seedling for each seed.

Compare with the results found in germinating the seeds of beet.

POT-HERB CROPS

The Pot-herb Crops include the various plants grown for "greens." Spinach, Chard, Dandelion, and Mustard are the most important of these. They all require for their best development a moist, rich soil that promotes quick growth of leaves and stalks, the parts used. To insure such growth, light applications of nitrate of soda or sulphate of ammonia are often made to the growing crops.

SPINACH

Spinach, pronounced and often spelled Spinage, is commercially the most important Pot-herb. It is sufficiently tender to make good greens and sufficiently tough to bear shipping long distances. Consequently it is raised in nearly all trucking regions and sent to near or distant markets. It is a cool-season crop, thriving in early spring and late autumn and hardy enough to live through mild winters. In the north it may be wintered over in cold frames, but in Virginia and other southern regions it requires no protection. In the latitude of New York a covering of litter or straw is often given.

The culture of Spinach is simple. For home use at the north the seed should be sown in spring as soon as the ground can be worked to advantage, being scattered sparingly in drills and covered with half an inch of soil. When the seedlings have five or six leaves they should be thinned to four inches apart, the plants pulled up

being used for greens. The main crop should be ready for use late in May or early in June, the ground being cleared in time for a crop of beans or other vegetables. In more southern regions the main sowing may be made early in September so that the plants are well grown by winter and will mature in early spring.

Spinach has been cultivated for many hundred years. It is thought to have originated from a wild plant native to Asia, called *Spinacia oleracea*. It belongs to the Pigweed Family. This is probably the reason why it is commonly attacked by a leaf-mining fly that develops in our native white pigweeds. This leaf miner is the most injurious insect enemy of Spinach. The infested leaves show discolored blotches through which the outlines of the footless maggots are readily seen. In northern regions spinach leaves that mature before the end of May are generally not infested.

SWISS CHARD

For summer and fall use at home Chard or Swiss Chard is the most desirable Pot-herb. It is really a beet, developed for leaves rather than roots. It is sometimes called Leaf-beet. Seed sown very early in spring in rich, moist soil will yield leaves large enough to use by early summer and a continuous succession thereafter until winter. The comparatively new variety called Giant Lucullus is a great improvement over the older sorts. The leaves of Chard are too tender to stand shipment, so they are seldom seen in the markets.

DANDELION

In a few trucking regions the Dandelion is an important commercial crop. Seed is sown in early spring in rich, light soil, the ground being kept well tilled until it is covered by the spreading leaves. The plants are large enough by fall to yield a cutting of leaves and may then be left until spring, with perhaps a light mulch in winter. In spring they are to be harvested and the roots should be plowed out or they will form new crowns that will blossom and scatter seed over the surrounding country. The varieties developed in France and offered by seedsmen are much better for crop purposes than our wild Dandelion.

Several other Pot-herbs are occasionally grown as crops. Various Mustards, the French Purslane, or "pusley," and Orach, another member of the Pigweed Family, are the most important of these.

The Kinds of Pot-herbs

{	Spinach
	Chard
	Dandelion
	Mustards
	Purslane
	Orach



SALAD CROPS: LETTUCE, CELERY, AND PARSLEY

LETTUCE

Types of Form

A cabbage lettuce, a Grand Rapids lettuce, and a Cos lettuce or mounted pictures from seed catalogues.

See how each type differs from the other types.

Harvesting Seeds

Lettuce plants gone to seed in school or home garden.

Let each pupil separate twenty seeds from seed-heads to use in germinating test.

Seed Germination

Twenty seeds for each pupil.

Determine the percentage of germination.

Plant part of the seeds in a window box and use the seedlings in drawing exercises on blackboard or paper.

CELERY

Varieties

Study two or three seed catalogues and make a list of varieties to plant for fall and winter use.

Seed Germination

Ten seeds for each pupil.

Determine the percentage of germination.

PARSLEY

Seed Germination

Twenty or more parsley seeds and five radish seeds for each pupil.

Place both kinds of seeds in the germinating dish.

Record germination. Determine which kind germinates first and the difference in time between the germination of the radish and the parsley.

What advantage would there be in planting the two kinds of seeds in the same row in the garden?

Growing Seedlings

Sow parsley seeds broadcast in a window box in north or west window. Seedlings grow slowly and do better out of direct sunshine.

Transplant occasionally to get a good root system.

In spring plant in outdoor garden.

ENDIVE AND CHICORY

Sow seeds of endive and chicory in the school garden or in the home gardens.

Plant in early spring, as soon as ground is in good condition, in rich soil and thin to eight or ten inches apart.

When well grown tie the outer leaves together with raffia to blanch the inner ones.

Some blanched hearts of Chicory as shipped from Belgium to America are pictured on page 42. It should be easy to grow similar ones here.



SALAD CROPS

The three most important Salad Crops are Lettuce, Celery, and Parsley. In addition to these, Endive, Chicory, Cress, and Water Cress are commonly grown in many regions, although they are not so generally used as the three first named.

LETTUCE

Lettuce finds a place in practically all home gardens and is grown in vast quantities both indoors and out for market. It is one of the most important truck crops in market garden regions. Lettuce has been grown as a garden plant for thousands of years. The original form from which it developed is unknown, though it is supposed to have come from the Wild or Prickly Lettuce, now an introduced weed in America, belonging to the great family of Composite plants.

The form most commonly grown is the Head or Cabbage Lettuce, of which many varieties are offered in every seed catalogue. This is in general the most satisfactory type either for home use or market. Seeds sown in drills in early spring soon develop seedlings that may be thinned to six to ten inches apart in order that each may have room to head. The soil should be loamy and rich. A light application of nitrate of soda when the plants are half grown is very helpful. Two or three plantings should be made at intervals throughout the summer.

Two other types of Lettuce are of value. The plants of the Curly or Grand Rapids Lettuce do not form compact heads, but have large leaves of value for salads and garnishing. The Cos or Romaine Lettuce produces long slender heads which are especially valuable for summer use, as this type stands hot weather much better than the others. It was formerly necessary to tie the leaves together near the top to blanch them, but self-closing sorts are now available.



CELERY

Celery is a garden form of Wild Celery, a plant of the large Parsley Family, called by botanists *Apium graveolens*. The wild form is native to great regions in Europe and Asia. The cultivated form has been in use for hundreds of years, though it is only during the last half century that it has become the universal favorite it now is. Before that it was a winter vegetable, grown in summer and carried into cellars in autumn to blanch before being used. About 1885 two important self-blanching sorts, White Plume and Golden Self-blanching, were introduced; these were earlier and easier to grow,

so they were helpful in extending the season and making the plant more popular. Many other sorts are now known.

Celery requires good care and a deep, moist, soil rich in decaying vegetable matter. The seeds are sown early in hot-beds or cold frames and the seedlings thinned to an inch apart and later transplanted, at least once before the final transplanting to the garden or field. At the first transplanting the tap-root should be pinched off to induce a strong development of other roots. In the garden the transplants are set six inches or more apart in the row, according to the variety.

Good tillage is given until the plants reach full size or nearly so. Then stalks are to be blanched by some method that will exclude the light. This used to be accomplished by setting the plants in trenches and filling the trenches with soil. This is still a good method for home gardens where the soil is deep enough. A common way is to set the plants in rows four feet apart and gradually hill up the sides with earth. Instead of this, boards are often used, set vertically along each side of the rows, or the plants are set in solid beds and boards placed along the outer borders.

Celery is commonly attacked by Leaf-spot or Early Blight. This is a destructive fungous disease that sometimes causes the loss of more than half the crop. It first shows as small, irregular, yellowish green spots upon the leaves. These enlarge and become brown and soon spread over most of the leaf. Spraying every two weeks with Bordeaux mixture is a preventive.

PARSLEY

Parsley is a member of the great umbel-bearing family, often called the Parsley Family. It is used for flavoring soups, stews, and salads, and especially as a garnish in serving meats and other foods. It is a biennial, though for garden purposes it is treated as a hardy annual. Seeds are sown in hot-bed, greenhouse, or window box in March, and the seedlings transplanted outdoors in May. Or the seed may be sown outdoors as soon as the ground is in good condition and thinned to six inches apart in the row.

Parsley is a cool-weather plant, requiring rich, moist soil for its best development. In the hottest summer weather it does better in shade than in full exposure to the sun. Plants may be taken up in autumn and planted in window boxes for winter use. The outer leaves and leaf-stems are pulled off for use, but care should be taken always to leave some to keep the plant growing. Three types of leaves are now grown—the Plain, the Curled, and the Fern-leaved sorts. The Dwarf Curled ones are most popular.

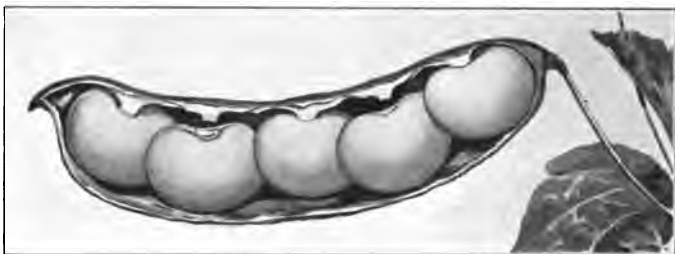
CRESS AND ENDIVE

In city markets small bunches of Water Cress are commonly sold for salads and garnishing meat dishes. This is a perennial plant found in our brooks and easily propagated either by seed or cuttings. It thrives best along the margins of streams, where the running water keeps it clean, healthy, and healthful, but it may be grown in almost any moist location where the water supply never fails. This is really a much more desirable

plant than the Garden Cress, which is easily grown in spring or fall in rich, moist soil. The leaves of garden cress are rather too peppery for most people to enjoy.

Endive is much more generally used in Europe than America. It is used both as a salad plant and as a pot herb for greens. For salads the leaves are blanched by tying them together. Seed sown very early in spring will develop into plants for use in summer, or seed sown in early summer will mature for use in autumn. There are two principal types—the Curled or Fringed and the Broad-leaved Endives.





PULSE CROPS: BEANS AND PEAS

BEANS

Types of Seeds

Collection of seeds of as many varieties as possible, gotten together with the help of pupils.

Learn to know each of these types:

- Pea beans or field beans
- String beans
- Shell beans
- Lima beans

Make a set of drawings for booklet.

Seed Germination

Ten beans for each pupil.

Determine the percentage of germination.

Leave seeds in the germinating dish until you can see easily these parts:

- Outer skin
- Thickened seed-leaves or cotyledons
- Root
- Plumule or little plant

Make a drawing for the booklet.

Root Nodules

Dig up plants carefully. Examine roots to see if little whitish nodules are present on them.

If bean roots in one garden have nodules and those in another do not, notice which plants are the more vigorous.

Enemies

Find pods affected by pod-spot or anthracnose. Draw.

Find beans in storage affected by bean weevil. Look at the insects through a lens.

PEAS

Types of Seeds

Collection of seeds including smooth white field peas, smooth blue peas, and wrinkled peas.

Sort out the peas into these three kinds:

Smooth field peas

Smooth blue peas

Wrinkled peas

Learn what varieties are generally planted for green peas in your neighborhood.

Seed Germination

Determine the percentage of germination of the peas to be planted in the outdoor garden.

Pea Weevil

Find peas in storage that show presence of pea weevil.

Study through a lens the appearance of the insects and the holes they make in the seed.

Ordering Seeds

Write an order on your local dealer or one of the seed houses for enough peas to plant your garden, naming a succession of varieties.



PULSE CROPS

BEANS

Two distinct species of Beans are commonly grown for garden purposes—the Field or Kidney Bean, *Phaseolus vulgaris*, and the Lima or Sugar Bean, *Phaseolus lunatus*. Both are believed to be natives of tropical America, and the typical forms of both are pole or climbing beans, although dwarf or bush forms of each are largely grown.

The Field or Kidney Bean serves two important purposes. It is largely used both in the condition of the ripened dry seeds and in that of the green seeds or pods. For shell and string beans both climbing and bush varieties are grown, the latter being most popular, while for the ripened field beans, only bush varieties are grown.

The Bush String Beans form one of the most important vegetable crops. They are commonly divided into the Yellow-podded or Wax Beans and the Green-podded Beans. The shape of the pods varies greatly in both colors, but in all good varieties when well grown the pod is thick and meaty and can be easily broken with little or no “string” along the inner edge. The seed is commonly planted either in drills or hills in garden practice, a succession of sowings being made about three weeks apart to produce successive crops. If no pods are allowed to ripen the vines will continue to bear a month or more. Early varieties of string beans are ready for use about seven weeks after planting.

Field beans are planted in rows two feet or more apart, the plants being about four inches apart in the row. On a large scale the seed is put in with seed drills, special care being taken to have the soil in good tilth, so that the tillage with hoe and cultivator may be easy and effective. After the plants are well grown, shallow cultivation only must be given to avoid disturbing the bean roots which grow near the soil surface.

The crop may be harvested by hand and tied in "shooks," but those who grow many acres generally use a two-wheeled bean harvester which does the work very rapidly, cutting off the stems close to the ground and leaving the vines in windrows. The pods were formerly shelled by hand flails, but in the more important bean-growing regions they are now threshed by special machines called "beaners." A yield of twenty-five bushels of shelled beans per acre is a good crop.

As the Bush Beans have largely taken the place of the Pole Beans for garden and field growth, so the Bush Lima Beans have taken the place of the Pole Limas in our gardens. There are three types of these Bush Limas, corresponding to the three types of Pole Limas: the large flat-seeded type, represented by Burpee's Bush Lima; the medium, thick, or potato-seeded type, represented by Dreer's Bush Lima, and the small seeded type, represented by Henderson's Bush Lima. The last named is the best for northern regions as it is earlier and hardier than the others.

All the beans belong to the great Legume Family and have the power of fixing nitrogen from the air by means of bacterial nodules on their roots. In most gardens where beans are grown the necessary germs are likely to

be present, but in soils where few nodules develop upon the bean roots it will be worth while to experiment with inoculation by means of special cultures. This ability of the bean to fix free nitrogen should be taken in consideration when planning for fertilizers. A loamy soil with a fair amount of humus is likely to require only potash and phosphoric acid for the growth of beans. The crop thrives on a clover sod plowed and put in good tilth. A soil too rich in nitrogen is likely to produce vines rather than seeds. In garden culture, however, it is sometimes worth while to hasten the early growth by a little nitrate of soda or similar fertilizer.

Beans being of tropical origin are essentially warm-weather crops. They are tender to frost and the seed rots in cold, wet soil. Consequently planting should be delayed until the soil is well warmed and the danger from frost is past. Lima Beans require more time to mature than the ordinary sorts and so should be given the sunniest location, especially in northern regions.

Enemies

Anthracnose, Pod-spot, or Rust as it is variously known is the most destructive fungus disease of the Bean. It shows on the young pods in the shape of small reddish brown spots that soon increase in size and become blackish in the center. The pod shrinks and the young beans inside often shrivel up so as to be of little value. The disease is most destructive in wet seasons and its spores are easily distributed if the vines are hoed or cultivated when they are wet. Consequently they should be tilled only when dry. The spores winter over on the diseased seeds, which start the infection the

season after. Consequently an important preventive measure is to choose seed from fields or pods in which the disease is not present.

The Bean Weevil is about the only insect enemy that is generally destructive to this crop. The eggs are laid inside the green pods by the small brown beetles. The larvae that hatch from these eggs feed upon the beans for about a month; then they change again to beetles. They are able to develop also in dry stored beans, but are easily destroyed in these by fumigation with carbon bisulphid.

PEAS

While the garden bean is a tender plant from tropical regions requiring a warm soil and season for thrifty growth, the Garden Pea is a hardy plant from northern regions requiring a cool soil and climate for its best growth. Peas have been cultivated for more than twenty centuries and probably were originally grown as garden plants in Asia, where the Wild Pea, *Pisum sativum*, is a native species. The characters have been so greatly modified that the garden varieties now grown, are great improvements over the original form. There are dwarf, medium, and tall sorts, and those with small or large seeds and pods. The Field Pea, grown for forage, is ranked as a special variety of the garden species.

The Garden Peas are commonly divided into two principal groups — the Smooth-seeded and the Wrinkled-seeded Peas. The Smooth-seeded sorts are firmer and hardier; the seed can be planted very early with little danger of rotting in the ground, but the resulting crop is poor in quality and soon becomes too hard to be

relished. The Wrinkled-seeded sorts are softer and more tender; if planted too early the seed is likely to rot in the soil, but the quality of the crop is very good and the peas remain on the vines in good condition for some time. Practically it is scarcely worth while to plant the smooth sorts, like Alaska, except to get two or three very early pickings. The smooth sorts may be planted as soon as the frost is out of the ground, but the others should not be planted until two or three weeks later.

Culture

The most approved way of planting Peas is to have two parallel rows about six inches apart, with about two feet distance between each double set. Then in the case of the taller sorts, brush may be placed in the six-inch space and serve for both rows, or in the case of medium or dwarf forms the vines will support one another. For early crops the dwarf varieties are planted, and for late the tall ones, though many people prefer to plant for midseason and late crops a succession of such a splendid variety as the Telephone. Peas thrive best on a light, loamy soil. On a heavy soil, especially if rich in nitrogen, they are likely to run to vine rather than to pods. A little quick-acting fertilizer in the rows at planting time helps to get the seedlings well started.

Enemies

The most destructive fungous diseases of Peas are the Spot and the Powdery Mildew. The Spot attacks stems, leaves, and pods, forming characteristic blackish blotches and interfering with the growth of the plant. The

planting of seed from fields free from the disease and adequate rotation are the chief preventive measures. The Powdery Mildew is often troublesome late in the season and in rather moist climates. The methods of preventing the Spot disease are also helpful for this.

The most destructive insect enemies of Peas are the Pea Aphis and the Pea Weevil. The Aphis, fortunately, is only abundant during occasional years and ordinarily is not troublesome. The Weevil is more regular in appearance. Its life-history is similar to that of the bean weevil. If all the pea weevils present in a locality in spring are destroyed by concerted action in fumigating stored peas with carbon bisulphid, there will be little trouble from the pest.





VINE CROPS: SQUASHES, MELONS, AND CUCUMBERS

SQUASHES

Types

Samples of different varieties or mounted pictures from seed catalogues of different types of squashes.

Let each pupil name the types that he has seen in garden, cellar, or market.

Seed Germination

Ten seeds of squash, pumpkin, or cucumber for each pupil.

Leave in the germinating dish until the root is an inch long.

Study the sprouting seeds to find these parts:

Outer seed-coat

Inner seed-coat

Seed-leaves or cotyledons

Plumule

Growing Seedlings

Plant twenty or more seeds in a window box or individual flower pots.

When the seedlings come up, watch to see how the plant gets out of the seed-coat.

Write a story telling what you see and illustrate the story by drawings.

Enemies (May to October)

Find eggs and the various stages of the black squash-bugs. Try the plan of trapping the adults in early summer by placing old shingles or boards near the plants. Look under these early in the morning to find the bugs.

Find examples of striped or spotted cucumber-beetles. Try cheap tobacco powder as a repellent.



VINE CROPS

The Vine Crops belong to the great family of Cucurbits (*Cucurbitaceae*). The native home of most species of this group is in tropical regions, where an abundance of warmth and moisture furnish ideal conditions for growth through long seasons. So it is natural to find these plants easily injured by frost and unable to grow in cold soil. They require the warmest summer weather for their development, and in northern regions must be given every possible advantage in inducing a rapid start and an early maturity.

The principal Vine Crops are easily separated into three important groups — the Cucumbers and Muskmelons of the genus *Cucumis*, in which the short-stalked pollen-bearing flowers are borne in clusters; the Squashes and Pumpkins of the genus *Cucurbita*, in which the long-stalked pollen-bearing flowers are solitary; and the Watermelons of the genus *Citrullus*, in which the pollen-bearing flowers are also solitary, but borne on short stalks.

In all members of the family the pollen-bearing, or staminate, and fruit-producing, or pistillate, flowers are separated, though borne upon the same vine. The pollen is carried from one kind of flower to the other chiefly by bees, especially bumble bees, which are very useful in this way.

CUCUMBERS AND MUSKMELONS

The Cucumber is a standard crop in every garden. It can be grown in a shorter season than the other Vine Crops, both because it is eaten green and because it matures more quickly. The fruits for pickling are pulled when quite small and those for eating fresh as soon as they reach full size. The Cucumber is one of the most important truck crops, especially in the south, from whence vast quantities are shipped north in winter and early spring. It is also an important crop for forcing houses in the north. Colonies of bees are kept in the Cucumber houses to bring about the pollination of the blossoms.

The Muskmelons are so variable in form and structure that they have been separated into several groups, of which the Cantaloupes and the Netted Muskmelons are the most important commercially. In the Cantaloupe the rind is hard and generally rough or scaly, while in the Netted or Nutmeg Muskmelons the rind is softer and netted or reticulated on the outside. The famous Rocky Ford melons are typical examples of the netted type, which includes the most popular varieties now grown. In certain regions the crop of these melons is the most important product of the soil.

SQUASHES, PUMPKINS, AND GOURDS

The Squashes, Pumpkins, and Gourds are closely related plants, the first named being the most important as a vegetable. Two types of Squashes are commonly grown — the Bush or Summer and the Running or Winter Squashes. The Summer Squashes are related to the

Pumpkin. They vary greatly in form, some having the shape of a Pumpkin, others having a long crook-neck, and others having an outline suggestive of a pineapple. The vines of these run little or not at all, and so the hills may be planted only about four feet apart. The Winter Squashes vary also in form, the Hubbard, shown on page 60, and the Turban, shown on this page, being two of the most distinctive types. The vines of these run so far that the hills must be about eight feet apart.



TURBAN SQUASH

WATERMELONS

Most Vine Crops appear to be native to tropical America, but the Watermelon is native to tropical Africa.



DEVELOPING HUBBARD SQUASH, SHOWING WITHERED FLOWER

It is now grown in our southern states to a greater extent than elsewhere, vast quantities being shipped to northern markets every year. The long warm season and light soil of many southern regions afford ideal conditions for Watermelons to develop,

but even in the short seasons of the northern states

certain selected varieties may be brought to maturity, especially if the seedlings are started early in the hot-bed or greenhouse. The Citron Melon is a special type of the Watermelon which is grown for preserving.

Enemies

The Vine Crops are subject to serious injury by several insects. As soon as they come up they are likely to find the Cucumber-beetles and the Black Squash-bug waiting to attack them. When the true leaves develop they are liable to attract the little Melon Aphis, and when the stems begin to lengthen the Squash-vine borer is likely to feed upon them.



SQUASH BUG
Magnified

There are two kinds of Cucumber-beetles—the Striped, more common in the north, and the Spotted, more common in the south. Both attack Melons, Squashes, and Pumpkins as well as Cucumbers. They eat the leaves and stems of the young plants and deposit eggs that hatch into larvae that burrow through the roots. Using cloth or wire screens over the young vines until they are well started is a helpful measure. So is a heavy mulching of refuse tobacco powder or an application of Bordeaux mixture.

About the only way to get ahead of the Black Squash-bugs is to place shingles or short boards near the plants: the bugs will seek these for shelter at night and may be collected early in the morning.

Vine Crops	Genus <i>Cucumis</i>	Cucumbers	{ Field Forcing
		Muskmelons	{ Cantaloupe Netted or nutmeg
	Genus <i>Cucurbita</i>	Pumpkins	
		Gourds	
	Genus <i>Citrullus</i>	Squashes	{ Summer or Bush Winter or Running
		Watermelon Citron melon	





**SOLANACEOUS CROPS: TOMATO, PEPPER,
AND EGGPLANT**

TOMATO

Seed Testing

Ten or more seeds for each pupil.
Find the percentage of germination.

Growing Seedlings

Start seedlings in window box in February or March.
Transplant to three-inch paper pots when they have
two or three true leaves.

PEPPER

Growing Seedlings

Start seedlings in window boxes, hot-beds, or cold
frames in March or April.
Transplant when they have two or three true leaves.
Set out in the garden when danger from frost is past.

THE NIGHTSHADE FAMILY

The Nightshade Family (*Solanaceae*) includes the Potato, Tomato, Pepper, Eggplant, Husk Tomato, and many wild plants. The Potato differs from the others in that it is the tuber rather than the fruit which is used for food, and so it has already been considered as a tuber crop.

The three important solanaceous crops whose fruits are used for food — Tomato, Pepper, and Eggplant — are native to tropical regions. Consequently they are tender to frost and yet require a long season for development. So the seedlings must be started in greenhouse, hot-bed, or window garden, that the young plants may be set out when danger from frost is past. They require hot weather for their best growth and should be given a good start at the time of transplanting by means of a rich soil or nitrogenous fertilizer or both. They should be started under glass one or two months before the time they are to be set out.

THE TOMATO

The various forms of the cultivated Tomato are derived from a plant native to the western part of South America. Although the plant has been in cultivation for more than three centuries, it is only during comparatively recent years that it has been generally used for food. It has now reached a high degree of development,

with many distinct types of plant and fruit and a great number of varieties.

The garden culture of Tomatoes is very simple. The plants are set out in May three to three and a half or four



TOMATO IN PAPER FLOWER POT

feet apart and given good tillage until the fruit is well set. It is better to hold the plants up with some support, either tying to stakes or using various forms of trellises. It is generally worth while to fasten a bit of stiff paper around the stalk of the plant when it is set out to prevent injury by cutworms.

The Tomato has lately become an important truck crop. Great quantities are grown in the south every winter for shipment to northern markets. It has also become an important greenhouse crop near large cities in the north.

PEPPER AND EGGPLANT

The Red Pepper is also a native of tropical America and was first discovered by Europeans when Columbus made his most famous voyage. It is often called Chili Pepper and belongs to the genus *Capsicum*. There are now many types and varieties, though the botanists think that originally there were only one or two wild

species. In garden culture the treatment is much like that of Tomatoes, though no supports are needed. It is a simple matter for any one to grow enough of these Peppers for home use.

The Eggplant is more difficult to grow than either the Tomato or the Pepper. It is essentially a tropical species and requires much hot weather to develop properly. It is grown to a considerable extent in the southern states, but very little in the northern. The plants require an early start and rapid growth for successful results.



II

FLOWER CROPS





From *The Flower Beautiful*

CHINA ASTERS IN A BAMBOO WALL HOLDER



ANNUAL FLOWERS

NASTURTIUM

Flower Structure

A flower for each pupil.

Study the structure of the flower. Find these parts:

The outer sepals

The colored petals

The nectar spur

The stamens

The pistils

Find out what part develops into the seed-pod.

Draw a side view of a flower.

Seed Harvest (Summer and Autumn)

Gather ripe pods from garden. Store for future use.

See the difference between the outer pod and the inner seed.

Growing Seedlings Indoors

Sow seeds of the dwarf nasturtiums in a sunny window.

Dig up part of the seedlings for drawings; leave some to grow.

CALIFORNIA POPPY

Flower Structure

Study buds and blossoms in garden or newly-picked in schoolroom. See:

- The sepals that fall off as the flower opens
- The petals
- The stamens
- The pistils
- The various stages of the seed-pod

Seed Harvest

Collect seed-pods in autumn. Store for sowing in early spring.

Seed Planting (Spring)

Early in spring sow the seeds sparingly in a little drill or furrow along the border of the flower garden.

Thin the seedlings to six or eight inches apart.

Keep the surface of the soil stirred and free from weeds.

In a garden where the flower grew the season before there are likely to be so many self-sown seedlings that sowing the seed is not necessary.

PANSY

Flower Show

Early in autumn or late in spring plan for a Pansy Show.

Let each pupil bring in a few attractive pansy flowers of as many colors as possible.

Invite parents or friends to send others. Have drawings of pansies on the blackboard and colored drawings mounted on paper.

Let pupils mount colored pictures from seed catalogues.
Let pupils make dainty invitations to give their friends.

DRUMMOND PHLOX

Planting Outdoors (Spring)

Early in May plant a package of seed in a row in the school garden, covering lightly.

When the seedlings are large enough to transplant let each pupil who has a place to grow them take a few home.

SWEET PEAS

Flower Show (Early Autumn)

A sweet pea flower show is well worth having in September, soon after the fall term opens. Have pupils and friends bring in as many kinds as possible.

Decorate the room with blackboard drawings of sweet peas and mounted plates from seed catalogues.

Label as many exhibits as possible with the name of the variety.

Germination Test

Shortly before it is time to sow sweet peas outdoors, let pupils test the germination of a few of the seeds they are going to plant. Always test all old seeds saved from the year before.

Growing Indoors

Plant seeds in late autumn or early winter in a window box in a sunny window. Select varieties used for forcing in greenhouses. Earliest of All is a good one for the purpose.

Water carefully. Furnish support. In a few weeks the plants will blossom. Use for drawing and language.

ANNUAL FLOWERS

Annual flowers are very satisfactory garden crops. The seed costs but little and the yield in beautiful blossoms follows soon after planting. Most of them can be grown in such limited space that no one need lack them even if a garden is not available. A box or a barrel may be made to produce a host of blossoms. There is space here to discuss only a few of the most popular of these flowers.

NASTURTIIUMS

Three common types of Nasturtiums are grown in our gardens. The most popular of these, perhaps, is the Dwarf Nasturtium, which has smooth, shiny leaves and beautiful irregular flowers.

The next in popularity is probably the Tall or Climbing Nasturtium, which differs from the Dwarf chiefly in its climbing stems and larger habit.

The third type is the Lobb's Nasturtium, which is known at once by its hairy leaves and stems: it is also a climbing sort.

These Nasturtiums are all natives of South America and belong to the genus *Tropæolum*. They are tender annuals of the easiest culture and yield a profusion of beautiful flowers, colored in tones of yellow, orange, and red.

THE CALIFORNIA POPPY

The California Poppy or *Eschscholtzia* is a native of California and Oregon recently introduced as a cultivated flower. It is a low spreading plant, reaching a height of twenty inches, with finely cut, glaucous foliage and large single flowers that were originally yellow, but are now developed into white, orange, red, and striped sorts. The sepals are united into a cap, which is dropped off when the petals open. Though originally a perennial, it is treated as a hardy annual in cultivation, the seed being sown where the plants are to flower as the seedlings are hard to transplant successfully. It is especially useful for the border of a garden.



CALIFORNIA POPPY

THE PANSY

The Pansy has been cultivated for so many centuries that the history of its origin is unknown. It is believed, however, to have originated from the Tricolored Violet (*Viola tricolor*), a charming little wild plant, abundant in Europe and parts of America. Like other violets this is a perennial, as is the Pansy when left to itself.

In garden practice the Pansy does best when treated as an annual, growing new plants from seed every year

and discarding them when the best blossoming period is past. The seed may be sown late in summer or early in autumn for spring flowering or in spring for late summer and autumn flowering. The Pansy does not thrive in direct sunshine in the hot weather of midsummer, but at other times it enjoys full exposure to the sun. The best Pansy seed is raised by specialists, who use great care in selecting strains and varieties.

THE DRUMMOND PHLOX

The various varieties of the Drummond Phlox are desirable garden annuals. They are derived from the original wild form found in Texas by the botanist Drummond, who sent the seed to England in 1836. Its beauty was at once recognized and numerous color variations were soon developed: white, pink, rose, lilac, scarlet, crimson and many combinations of these colors are now available. Variations in form have also developed, the most striking being the Star Phlox, in which the centers of the petals are prolonged into curious rays.

Phloxes are especially desirable for cut flowers and for massing along borders. They grow readily in sunny situations from seed sown outdoors after the early frosts, and bear transplanting as well.

THE TRUE POPPIES

Three distinct species and a great number of varieties of annual Poppies are in cultivation. The most popular are forms of the Corn Poppy, a wild plant native to Europe. The Shirley Poppies are the most beautiful of these. The leaves and stems of this type are small and slender and thickly covered with fine hairs. The flowers

will bear cutting and placing in water, though they last but a short time.

The forms that rank next in popularity have been derived from the Opium Poppy of the Orient, one of the oldest of cultivated flowers. The leaves and stems of this type are thick and succulent and have a smooth, hairless, glaucous surface. A great variety of single and double flowers belong to this group, some of the most beautiful being the Mikado, Snowdrift, and Fairy Blush.

The third species, the Iceland Poppy, is really a perennial, but in garden practice is classed as an annual. It is a plant with small leaves and slender leafless stems, a native of arctic regions, where it is often very abundant. All these Poppies are excellent for flower borders. They do not bear transplanting well, so the seed should be sown very early in spring where the plants are wanted. The seeds are small and care must be taken to cover very lightly if at all.

THE SWEET PEA

The Sweet Pea appears to have been in cultivation for more than three centuries. Originally a native of Sicily, the Wild Sweet Pea was improved by a great many flower lovers until in 1876 there were many good varieties. In that year, however, Henry Eckford of Shropshire, England, began experimenting with it, and continued for the rest of the century. During this time he originated nearly a hundred new varieties, which were wonderful improvements over the older ones. Consequently a large proportion of the Sweet Peas now grown are Eckford introductions. There are several distinct types of flowers and many beautiful colors.

The culture of Sweet Peas is simple, provided the seed is planted very early in spring. This is done in order that the roots may get a good development during the cool weather of April and May. A rich soil is desirable, though if too much nitrogen is present the plants are likely to run to vines rather than to flowers. The drill for planting should be hollowed out three or four inches deep and the seeds covered with an inch of soil. After the plants are several inches high the little trench may be filled in level. Birch or other brush, wire netting or some similar support must be given as soon as the vines begin to run. The flowers must be picked off, as the plants soon stop blossoming if the flowers are allowed to go to seed.





ANNUAL FLOWERS: THE COMPOSITES

COSMOS AND OTHERS

Flower Show (Autumn)

Have a little exhibit of the composite annual flowers — Cosmos, China Asters, Marigolds, Bachelor's Buttons, Zinnias, and others.

Separate the different sorts of flowers and label each sort.

Many pictures and suggestions as to arrangement may be found in *The Flower Beautiful*. Try to get a wall vase for the school. One is shown with China Asters in the picture on page 72.

Growing Seedlings (Spring)

Early in May sow seed of cosmos in a row outdoors. Keep the soil moist and free from weeds.

When the seedlings are about three inches high, dig up to transplant into the school garden or the home gardens of pupils.

CHINA ASTERS

Flower Types (Autumn)

Bring in various aster blooms and compare them to see likes and unlikes.

A perfect aster of any of the double varieties should be double to the center. See which have this character.

Seed Harvest (Autumn)

Mark several perfect blossoms by tying a bit of string or raffia around the stem. Leave these flowers on the plant.

When the petals have withered, pick the flower heads and pull off the seeds to store away and sow next spring.

Growing Seedlings (Spring)

Early in spring sow aster seeds outdoors in one or more rows. Sow the seeds about half an inch apart and cover with a third of an inch of fine soil.

Keep the ground moist and free from weeds.

When the seedlings have four or five leaves, transplant to flower borders at school or home.

Make drawings of the seedlings for the flower booklet.

MARIGOLDS

Harvesting Seeds (Autumn)

Gather the ripened flower heads of the marigolds in the garden and remove the seeds. Save in a box, keeping in an unheated room where mice cannot get at the seeds.

Growing Plants Indoors

Sow seeds of dwarf marigold in a window box, covering lightly.

When the plants have two true leaves in addition to the seed leaves, transplant into small paper flower pots, one for each pupil.

Let pupils water and care for the plants until they bloom. Then let each take his own home.

Growing Seedlings (Spring)

Sow seeds of both types of marigolds in the school garden early in May.

Keep the soil moist and free from weeds.

When the seedlings have two or three true leaves, let such pupils as have places to grow flowers take the seedlings home to transplant in their home gardens.

Make drawings for the flower booklet.



THE COMPOSITE ANNUALS

The great family of composite plants of which the sunflower, thistle, and daisy are familiar examples includes several of the most beautiful annuals. The type of flower in this family is capable of great variation through the modification of the form, size, and color of the little florets crowded together in a head. Consequently in most of the annuals belonging to the composite family there are many types of form and color. Five of the most important of these flowers are the Cosmos, China Aster, Marigolds, Bachelor's Button, and Zinnia.

COSMOS

The Cosmos is one of the newest garden annuals. It was introduced only during later years of the nineteenth century. Mexico was the original home of the plant. The varieties first offered grew very tall and bloomed very late, but by careful selection dwarf earlier-flowering forms were soon developed. Most of these bore white, pink, or crimson flowers and were derived from the species called *Cosmos bipinnatus*, but lately new forms derived from the yellow-flowered *Cosmos sulphureus*, also a native of Mexico, have been introduced. The variety Klondike is a hybrid between the two species. The largest flower yet produced is shown by the beautiful pink variety Lady Lenox.

The Cosmos is one of the most useful annuals either for border gardens or interior decoration. Seed may be sown in good loamy soil as soon as the early frosts are past, and the vigorous young seedlings transplanted about three feet apart along a wall, fence, or the open border. They grow rapidly. It is often desirable to pinch out the terminal bud of the main stalk in order to induce a spreading bushy habit. It is well to plant the late flowering sorts in a sunny sheltered corner where the early frosts of autumn will not harm them.



COSMOS FLOWERS

CHINA ASTERS

China Aster seeds were sent from China to France about 1730. A little later they were introduced into England and America. These early flowers were single forms, resembling an Ox-eye daisy in structure. The various double types now grown have been developed since. The modern Giant Comet and Ostrich Plume types are wonderfully beautiful and should be grown by every lover of flowers.

The natural season for these Asters is early autumn, the time when they are most needed in the borders.

Seed sown in drills outdoors early in May will soon develop into vigorous seedlings which may be transplanted to the bed or border where the blossoms are wanted.

Great numbers of Asters are grown to be sold by florists in the cut-flower trade. For this purpose long



CHINA ASTERS
The Comet Type

stems and perfect flowers are necessary. The buds are sometimes eaten by blister beetles, which should be collected and killed. The plants are likely to suffer from a sort of blight if grown repeatedly in the same soil. To prevent this, rotation and careful seed selection are necessary. The China Aster is called by botanists *Callistephus hortensis*.

MARIGOLDS

Two distinct species of Marigolds are commonly cultivated; the Tall Marigold is *Tagetes erecta*; the Dwarf or French Marigold is *Tagetes patula*. Both have been in cultivation for more than three centuries and have been developed into many varieties.

The colors of the Tall form range only through yellow and orange, while those of the French range through yellow, orange, brown, and red. The color tones are

remarkably rich. There are single and double varieties in both species. The Dwarf forms are desirable for bedding purposes, while the Tall forms are better suited to irregular borders, where the flowers make a brilliant show from August to October.

The culture of both is easy: sow the seed outdoors in spring when danger from frost is past and transplant the seedlings when two or three inches high to the place where they are to bloom. The marigolds have so strong an odor that they are not much used for cut flowers.

BACHELOR'S BUTTON AND ZINNIA

The Bachelor's Button is one of the most popular hardy annuals. The many varieties have been developed from a plant native to southeastern Europe called by botanists *Centaurea cyanus*. The flowers range to many colors of unusual purity of tone, held on long slender stalks that give them a very decorative effect. They are of easiest culture outdoors and extremely useful for cut flowers and border gardens.

The Zinnia is often called Youth and Old Age. The original single form was *Zinnia elegans*, a native of



MARIGOLDS IN A WALL FLOWER-
POCKET

Mexico. Double varieties were developed in France about 1860. Since then many new sorts have been introduced. The flowers are remarkable for their range of colors, though these are largely hard and metallic rather than soft and pleasing. The flowers also are rather stiff and often do not appeal to cultivated tastes. Seed is sown in spring out of doors, the young seedlings being transplanted later to the border garden where they are to flower.





HARDY PERENNIAL FLOWERS

COLUMBINES

Growing Seedlings (Spring)

A collection of columbines is especially desirable for the school border garden.

Sow the seed sparsely in a drill early in spring, cover lightly, and keep well watered.

When the seedlings are well up, thin to five inches apart, transplanting those taken up to another row.

Early the next spring transplant to permanent positions in the border, leaving ten inches between the plants.

Give surplus plants to pupils.

Harvesting Seed (Summer)

As the columbine blossoms fade they are followed by the characteristic seed-pods. Cut these off after they begin to ripen but before they split open. Lay them in a box and when they split open thresh out the seeds.

Save some of the seed for future planting in the school garden. Give the rest to such pupils as will agree to plant at home.

PEONY

Border Bed

Plant peony roots late in autumn or early in the spring in a partially shaded part of border.

Have the soil deep and very rich.

Flowers for Decoration

Cut the blossoms a little before they are ready to open. Place in water in a flower bowl and keep out of direct sunshine.

Give the peony bowl plenty of room for display. Do not crowd it on a table with many other things.

PERENNIAL PHLOX

This is a good plant for the border garden of the school. If there is a long vacation in summer cut off the tops of the plants in June so that there will be a crop of blossoms in September.

IRISES

Border Garden Collection

Be sure to start a collection of Irises for the border garden. It is probable that garden owners who have plants will willingly contribute two or three. Get as many sorts as possible.

After the plants have been established a year or two they may be divided to advantage, and soon the school will be able to distribute many to the homes of the pupils.

Flowers for Decoration

Irises are particularly effective for indoor decoration. Cut the stalks just before the first flowers begin to open

and pull off each day afterwards the faded blossoms. The buds will open in succession. Do not crowd the Iris flowers in the vase or flower jar.

Sunflower Family Exhibit

For one week in autumn arrange an exhibit of as many kinds of flowers of the composite type as you can get. Use both wild and cultivated sorts. The list might include any of these: Asters, Boltonias, Chrysanthemums, Coreopsis, Coneflowers, Dahlias, Daisies, Goldenrods, and Sunflowers. Some Coreopsis flowers are pictured on page 89.



THE HARDY PERENNIALS

The Hardy Perennials form one of the most important groups of flowering plants. They have the great advantage over the annuals in that when once planted under favorable conditions they will continue to thrive for many years, yielding with each new season a display of foliage and flowers that is of greatest importance in beautifying the landscape or decorating the home. There are so many of these plants now available to gardeners that we can here study only a few of the most important types.

COLUMBINES AND ANEMONES

For delicate grace of structure and exquisite beauty of color few perennial flowers can rival the Aquilegias or Columbines. The native Wild or Canada Columbine is widely distributed east of the Rocky Mountains and closely related forms are found on the Pacific Coast. Many other species from this and other countries have been introduced to garden culture as well as many hybrids developed by horticulturists. In some forms the nectar spurs are very long, giving the flower an extremely decorative effect. The Columbines thrive in moist soil or sandy loam with full exposure to sunshine.

The Japanese Anemones or Windflowers are attractive border plants on account of the large white or pink blossoms that appear in August or later in the season.



PEONIES IN A FLOWER JAR

The flowers are held singly on the ends of erect branching stalks that rise a foot or more above the main foliage. Some varieties are single, others semi-double, and others very double. The flowers last well when cut for indoor use and the plants are hardy even in the more northern states.

PEONIES

The Peony is one of the oldest, hardiest, and most showy of border perennials. One form at least is believed to have been grown for thousands of years, and more than two hundred distinct varieties are now in cultivation. Most of these have been developed from a wild Peony native to Siberia, either directly or through hybridizing with a few other species native to Europe and Asia. The flowers vary greatly in color, the tones ranging from white through all possible tints and shades of red, violet, lilac, and purple. They vary so in form that they are arranged in eight distinct classes, thus:

Single	Crown
Japanese	Bomb
Anemone	Semi-rose
Semi-double	Rose or Double

These several types represent the various stages, from a single flower with a row of petals around the outside and clusters of stamens and pistils inside to the fully double form in which both stamens and pistils have been transformed into petal-like bodies called *petaloids*.

The color tones of Peony petals are so delicate that they soon fade when exposed to direct sunshine. Consequently the flowers remain in good condition longer when the plants are in partial shade. A border on the

north or east of trees or shrubs is a good place for Peonies. They require a very rich soil: before planting the bed should be dug out to a depth of three feet and a good compost placed in the bottom. Newly set plants do not reach their full development for several years, so that when once established they should not be disturbed for a long time. The blossoming period extends through May and June. The flowers develop to best advantage if the stems are cut before the bud opens and placed in water in a cool room away from direct sunshine.



Peonies are multiplied by divisions of the erect, thickened rootstocks.

PERENNIAL PHLOX

PHLOXES AND IRISES

The Perennial Phloxes deserve the popularity they have long had as favorite flowers for border gardens. They are inexpensive and easy to establish and the plants continue thrifty for many years. The long panicles of lovely blossoms make a very attractive display out of doors and remain in good condition for many days when cut for indoor decoration. They multiply by division at the root, so that a good-sized clump will furnish many new plants. Seedlings are not so likely to yield good flowers. Phloxes thrive best in

a rich, moist soil. Their season of bloom may be prolonged by cutting off the flowering shoots before the petals fade. The prevailing colors are red, white, pink and purple, with many combinations of these.

The Irises are among the most beautiful of all flowers. The broadly expanded petals appearing in succession



ORIENTAL IRISES IN A JAPANESE
FLOWER JAR

upon the tall stems combine with the sword-like foliage to make one of the most decorative of floral combinations. There are many sorts of Irises: they are commonly classified into two groups according to the nature of their roots. Some Irises grow from bulbs: these are the Bulbous Irises; other Irises grow from rootstocks or rhizomes: these are the Rootstock Irises. The Bulbous Irises include the Spanish Irises and the English Irises, but are comparatively unimportant.

The German Iris is the most familiar type of the Rootstock Irises. It has long been a favorite flower and has stayed in cultivation for years in many old-fashioned gardens. It has many varieties, with the colors of the flowers showing exquisite tones of yellow, violet, purple, blue, and red. The Siberian Iris is a taller, more

slender type, which is good to plant just back of the German varieties. The Japanese Irises are the largest of the group, splendid flowers held on stems which are often three or four feet long. There are also many other less common types of Irises, most of which are beautiful. The flowers of all will open in succession if the stems are cut and placed in water.

These various Irises are among the most satisfactory perennials for border gardens. They complete their seasonal growth late in summer and should be transplanted early in autumn, so as to become established before winter. The Japanese varieties will not flourish in soils containing lime, so care should be taken in applying bone meal or similar fertilizers to the Iris bed.

THE COMPOSITES

The great sunflower family or Compositae contains several attractive perennials suitable for border gardens. In these blossoms many tiny flowers or *florets* are crowded together to form a compact head. The individual florets around the outside commonly form conspicuous *ray florets* as in the single daisies.

The plants which we call Wild Asters the English people call Michaelmas Daisies. They are so abundant along our roadsides and in our fields and woods that we do not appreciate them for garden culture as fully as our English cousins do. They are, however, probably the most desirable plants for flowering late in autumn for the border garden. They are hardier than the Pompon Chrysanthemums and will thrive with less attention. The flowers stand several degrees of frost without injury, so they are able to make a brave showing

through October and even into November. Some species bloom in August, but the larger and more attractive ones come in September and October. The New England Aster, of which there are several distinct varieties, is one of the best species for garden use.

The Boltonias or False Chamoniles are tall aster-like flowers which are indispensable for late blossoming in the border garden. They are taller than most of the asters and combine finely with them, both as to form and color. Two common kinds are now grown, one white, the other lavender-pink. The latter is the larger and more attractive. It has also a dwarf variety growing but two feet high. All three Boltonias are hardy and of easy growth. When established the clumps enlarge by means of spreading rootstocks and produce great masses of attractive flowers.

CHRYSANTHEMUMS AND DAISIES

We love the Crocus and the Snowdrop because they appear before the snow is gone and show that spring has come again. So we love the hardy Chrysanthemums because they are the last of the season's flowers and remain beautiful even when hidden by the first snow of the new winter. They are almost as hardy as the wild asters and are the chief dependence of northern gardens for outdoor blossoms in November. They are often called Pompon Chrysanthemums because of the small size of the flowers. The flowers show all the colors of the large chrysanthemums, the yellows and reds being especially attractive. The plants are hardy save in the most northern states and reproduce rapidly through the multiplying rootstocks. They are most

effective when grown in masses in the borders, where their late blossoms will be appreciated.

The charming little English Daisy is not much grown in American gardens, but it is an admirable plant for spring blossoms as edging for a border garden or a mixed flower bed. While the wild form in England is a so-called single flower, having a yellow center and white rays, the cultivated Daisies are double or nearly so. The flowers are white, pink, or red and in improved sorts reach a diameter of two inches.

The plants commonly are propagated from seed sown in August, the seedlings being wintered in a cold frame or under protection of loose litter.

They blossom the following spring. The plants may also be propagated by division of the crowns. The best results are obtained by starting a new crop of plants from seed each summer.

The Shasta Daisies are very different from the English Daisy. While the latter is only a few inches high the former is a tall branching plant with splendid flowers of the single composite type. This plant is one of the most notable productions of Luther Burbank, the famous plant-breeder of California. The newer varieties are great improvements over the original form.



POMPON CHRYSANTHEMUMS

GOLDENRODS AND SUNFLOWERS

We are so used to seeing the Goldenrods in our fields and along our highways that too few of us appreciate their beauty. Very few perennials can compare with them, however, and in other countries they are highly prized for garden planting. The color harmonies of the asters and goldenrods in American landscapes are most beautiful and these plants are well worth growing together in border gardens, especially in front of thickets of shrubs or trees. The species found in any locality serve very well for garden planting. They may readily be transplanted late in autumn or early in spring to rich, moist soil. With good treatment they improve greatly in the garden.

Various other composite perennials are more or less grown in border gardens. The various Sunflowers, Pyrethrums, Coneflowers, and Heleniums are the most important of these. They are all hardy and of easiest culture.



SPRING-FLOWERING BULBS

Planting Outdoors (Autumn)

During October the pupils should plant crocuses, tulips, jonquils, and daffodils. Cover to a depth of about four times the height of the bulb.

Late in November the bulb bed should be mulched with about six inches of fallen leaves, lawn clippings, or strawy manure, as a protection through the winter.

Late in March this mulch should be removed to enable the leaves and flowers to come up properly.

Planting Indoors (Autumn)

Practically all of the spring-flowering bulbs may be grown to advantage by pupils for winter flowering at school and home.

Plant in October in paper flower pots or ordinary flower pots. Set away in the basement cellar or bury outdoors under a foot of leaves. After six to ten weeks the roots will be well grown and the bulbs may be brought to the light and heat of the schoolroom to complete their growth.

Grow at least a few large hyacinth bulbs in hyacinth glasses as shown in the picture above.

Bulbs grown by pupils at school should be taken home when the blossom appears.

Precise direction for planting each kind of these bulbs both outdoors and in school may be found in *The School Garden Book*.

A special booklet of drawings, stories, and pictures cut from seed catalogues should be made upon this topic.

Ordering Bulbs

Look in magazines for advertisements of dealers in bulbs. Send for some catalogues.

Let each pupil write as an exercise in language an order for a dollar's worth of bulbs, selecting the kinds he would prefer.

Encourage each pupil who so desires to send off such an order for his home planting.



SPRING-FLOWERING BULBS

The spring-flowering bulbs, like the hyacinths, tulips, daffodils, crocuses, and several kinds of narcissi, form one of the most important groups of flowering plants. They are used in enormous quantities for planting in outdoor gardens, as well as for forcing indoors in greenhouses and window gardens. During winter and spring millions of the blossoms forced in greenhouses are sold in all our cities.



HYACINTH BULBS OF GOOD SIZE

Most of these bulbs are grown in Holland and are imported each year. So they are commonly called Dutch bulbs. Many experiments have been made of late in growing these bulbs in America. It has been found that they can be produced successfully even in such widely separated states as North Carolina and Washington, so that it is probable that in the future bulb growing will become an important industry in this country.

HYACINTHS

The common Hyacinth is derived from a species that originally grew wild in Syria and Asia Minor. It is called *Hyacinthus orientalis* or Oriental Hyacinth. Practically all the bulbs are now grown in Holland, so it is

generally called the Dutch Hyacinth. The bulbs are used largely for both outdoor planting and indoor forcing. For the former purpose they should be put in the ground early in October, with the bottom of the bulb six inches from the soil surface, so that the roots will have plenty of time to grow before freezing.



A DUTCH HYACINTH

For indoor forcing the bulbs should be potted up in autumn and set away in a cool cellar or basement for about six weeks, until the roots are well developed and the crown of leaves has broken apart. Then they may be brought to a lighted room. The single varieties

are very attractive when grown in water in hyacinth glasses. Small bulbs of these same Dutch Hyacinths are sold as Miniature or Dutch Roman Hyacinths. They are cheaper than the large ones, but serve very well for



From The School Garden Book

PICOTEE-EDGE TULIPS

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school use, especially for planting in small paper flower pots or for crowding together in broad flower bowls.

The Roman Hyacinth is a smaller and more slender variety than the Dutch Hyacinth. It blossoms earlier and the bulbs are cheaper. Millions of bulbs which are grown chiefly in southern France are forced every year by the florists. It is one of the best plants for winter forcing in schools. It is often called the French Roman Hyacinth, and sometimes the Italian Roman Hyacinth.

TULIPS

The Tulip has been prized in Europe as a decorative flower for nearly five hundred years and in Turkey for a much longer period. It was introduced into Holland in the sixteenth century and was the cause of the most famous flower craze that has been known. About 1634 the people of Europe were affected by what was called "Tulipomania," and for a few years speculated in Tulip bulbs to such an extent that the government had to stop it. There are eighty-three recognized species of Tulips and an almost unlimited number of varieties.

Tulips are largely planted for ornamental beds in set designs of colors. They are also very useful for border gardens and vast numbers are forced by florists for the winter and spring trade in cut flowers. The single varieties are much more beautiful than the double ones.

NARCISSUS GROUP

Many attractive species of spring-flowering bulbs are found in the genus *Narcissus*. These include the Daffodils, Jonquils, Chalice-flowers, Poet's *Narcissus*, and other well-known forms. The single Daffodils are

characterized by having large crowns or "trumpets" of beautiful tones of yellow. In the Polyanthus group there are several blossoms upon one stalk: the Paper White is one of the best of these. Another is the Chinese Sacred Lily, which is grown in China, the bulbs being imported into America in rush baskets, each basket holding sixty of the large bulbs. The flowers develop readily when the bulbs are placed in water.

CROCUSES

The Crocuses are among the earliest of the spring-flowering bulbs. The kinds commonly planted blossom in sheltered corners beside snowbanks, almost as soon as the latter have begun to melt. The bulbs are solid rather than scaly, so they are called corms. About seventy species of *Crocus* are recognized by botanists, though only a few of these are commonly cultivated. Several bloom in autumn rather than in spring, but the latter are much more satisfactory in cultivation than the former.



SUMMER-FLOWERING BULBS

Planting Tuberoses (Spring to Autumn)

A few tuberoses should be planted early in May in the border garden at school. They will probably be in blossom when school opens in autumn.

Growing Gladioli (Spring to Autumn)

Gladiolus bulbs can be bought from the seed-houses for a cent each. They are solid corms rather than scaly bulbs and each has a thin loose outer covering as shown in the picture above.

Plant some in the school border garden and encourage each pupil to plant a few in his home garden.

Take up the bulbs before freezing weather in autumn and store in a cool cellar where they will not freeze.

Growing Dahlias (Spring to Autumn)

Dahlia tubers cost little to begin with and multiply rapidly from year to year. A collection of good varieties in the school garden may be gradually distributed to pupils to the great advantage of the home gardens.

SUMMER-FLOWERING BULBS

For the sake of convenience four sorts of plants not closely related may be arranged under this heading: they are the Tuberose, the Dahlia, the Gladiolus, and the Lily. The word bulbs as here used must be taken in a very broad sense, for the roots we plant of Tuberose and Dahlia are really tubers and those of the Gladiolus are solid corms, the Lilies alone being scaly bulbs.

THE TUBEROSE

More than four centuries have passed away since the Tuberose was first grown as a garden flower. Its history during this long period is most interesting. Originally a native of Mexico, it found its way to India, though how or when is not known. About the year 1500 it was taken to Europe and cultivated by a comparatively few flower lovers for many years before it was generally dispersed.

These early Tuberoses were all single flowers, but about 1780 a double form was developed in Holland. Then for nearly a hundred years these flowers increased in popularity, being very fashionable in America just after the Civil War. In 1865 a dwarf variety, Pearl, was introduced. It soon became a leading sort. At present, however, Tuberoses are little used here except for garden culture and funeral flowers. Enormous numbers of the bulbs are grown, however, in North Carolina, most of them being exported to European and other countries.

In all but the most northern states Tuberoses are

easily brought into blossom in summer and autumn, if planted in loamy soil after danger from frost is past. In more northern regions it is generally desirable to start the bulbs in hot-beds or greenhouses in order to get early flowers.

THE GLADIOLUS

The modern *Gladiolus* may certainly claim to be one of the most beautiful garden flowers. The graceful sword-like leaves and the long spike of blossoms, whose petals display such exquisite tints and shades, combine to make a distinctive harmony of form and color. A great number of sorts are now cultivated. Most of them have been derived from a comparatively few original species that were chiefly natives of South Africa.

The bulbs are solid corms, which may be planted in fairly rich loamy soil, almost as soon as the ground can be worked in spring, and in succession every two weeks until the last of June. The flowers open finely if the stalks are cut and placed in water as soon as the lowest blossom appears. New bulbs are formed above the old one each year. These should be dug up in autumn and stored in a cool, dry, frost-proof cellar until the following spring.

DAHLIAS AND LILIES

The *Dahlia* is really an autumn rather than a summer-flowering plant. While many sorts are readily brought into blossom in July or August, the chief show is likely to be exhibited in September. The plant has been in general cultivation only about a century, although in its original home in Mexico it has been known as a garden flower for a much longer period. Several distinct types



SPIKES OF GLADIOLUS FLOWERS

of flowers are now grown, the most important being the large double Cactus Dahlias and the Single Dahlias. The Cactus types are perhaps the most beautiful.

Dahlia roots are tubers with buds at the upper end.



CACTUS DAHLIAS

Single tubers planted when danger of frost is past will send up stalks that will blossom late in summer or early in autumn. The roots must be dug up after the leaves are killed by the frost, and stored for the winter in a dry, cool, frost-proof cellar.

The Lilies have always been noted for their grace and beauty. There are many different kinds, natives of various lands as well as many hybrid sorts de-

veloped by gardeners. The flower is arranged in sets of threes, the three outer sepals and the three inner petals being so much alike that they are said to form the perianth. There are six stamens and a three-lobed pistil. The scaly bulb of the Lilies should be planted early in autumn. Most of them thrive best in a light, porous soil in which surplus water quickly drains off. The White Bermuda Lily or Easter Lily is forced in greenhouses in vast numbers every winter for spring flowering.

III

FRUIT CROPS





PATTEN'S XX PLUM; A HARDY HYBRID



POMACEOUS FRUITS: THE APPLE

Exhibit of Apples

Have pupils bring in as many varieties of apples as they can, selecting especially those kinds whose names are known.

Arrange each sort on a separate sheet of paper and add a card giving the name of the variety. It is well to have each set so placed as to show all sides, that the pupils may see the characteristics of each variety.

Invite some fruit grower to look over the names to see that they are correct.

After the pupils have had a chance to look at the exhibit repeatedly, say for a week, turn the name cards down and try each member of the class on a recognition test. Repeat the tests until the varieties are easily recognized.

Judging Apples

Let each pupil copy the score card herewith and judge a few of the best sets of apples. Repeat once or twice after intervals of a few days.

Uniformity of size	20
Typical shape for variety	15
Typical color for variety	15
Freedom from bruises	10
Freedom from insect injury	20
Freedom from fungous injury	20
	<hr/>
	100

Varieties of Apples

Ask each pupil to find out what varieties of apples grew best in his orchard. From the list brought in make a list of good varieties for your locality, arranging them under these headings:

SUMMER

AUTUMN

WINTER

Insects

What leaf-eating insects affect apple trees in your locality? Keep some of them under observation at the school.

What kinds of bark-lice or scale insects can you find upon apple trees?

If you do not know the name send specimens to your State Experiment Station.

What fruit-eating insects affect apples in your locality? Bring injured apples to school.

Mice and Rabbits

Are these animals injurious to young trees in your neighborhood?

What means of preventing their injuries have you seen tried?

THE APPLE

The Apple is the King of Fruits. In general usefulness, in ease of production, in geographical distribution, and in length of season it is without doubt beyond all rivalry. It would be difficult to determine the precise quantity of apples grown yearly in North America, but the product has been estimated at nearly two hundred million bushels. In 1907 more than one and a half million barrels were exported from the United States, chiefly to Great Britain and Germany.

The development of the Apple has been coincident with the development of the human race. Wild Apple trees grew in parts of Asia and Europe where man began to grow in knowledge of the arts that led to civilization, and the use of apples for food and their improvement by cultivation extends far back of recorded history. This wild Apple of Europe is called by botanists *Pyrus Malus*: our cultivated apples, as distinguished from Crab apples, practically all belong to this botanical species. Wherever civilized man has gone to make his home Apple trees have followed, so that the species has been distributed well over the globe. The trees have grown under almost all conceivable conditions and have varied in infinite ways. Among the billions of seedlings that have sprung up a very few have borne fruit that appealed to man as of especial value. These have been preserved by grafting upon other seedlings, so we have today hundreds of improved varieties, giving

us a wide choice of fruits — early or late, sweet or sour, large or small, of good quality or of poor, red, yellow, green, or white.

Commercial Apple Regions

While the Apple is grown to a greater or less extent over most of the temperate parts of North America there are five great regions where the fruit is a staple commercial product. These regions have been given the following names by F. A. Waugh:

1. The Lake Ontario Region: parts of New York, Michigan, and Ontario.
2. The Mississippi Valley Region: Illinois, Missouri, and parts of Ohio, Indiana, Kentucky, Kansas, and Arkansas.
3. The Allegheny Region: parts of Pennsylvania, Maryland, West Virginia, Virginia, Tennessee, and North Carolina.
4. The Nova Scotia Region: part of Nova Scotia.
5. The Pacific Coast Region: parts of Washington, Oregon, and California.

Outside of these commercial Apple regions the fruit is grown in great quantities for home use and local sale. The trees thrive in a great variety of soils and situations, and amply repay the slight care required to keep them in bearing condition. While some soils are better than others, the trees will grow almost as well on any soil that is not waterlogged, a deep, rich, well-drained loam being most desirable. Clean, vigorous, two-year-old trees with well-formed heads should be chosen for planting, and set at distances of forty feet apart each way. The soil should be well prepared before planting and

kept in good condition afterwards. There is little use in setting apple trees in small holes in grasslands and then leaving them to fight for life unaided. On a small scale especially for the home orchards, young trees can be kept thrifty by heavy mulching, being sure to band the trees with wire netting to prevent injury to the bark by the mice that are likely to seek shelter under the mulch. In orchard practice, however, tillage early in the season followed by a cover crop later is the best procedure, except in hill regions.

Wild Apples

In many regions where Apples have been grown for generations wild or native Apple trees have sprung up. As a rule these bear natural fruit of little value, but such trees are readily top-grafted to desirable varieties. If the trees are small they can be made over by inserting a very few scions, but if large more are needed. In either case the work is well repaid by the increase of the crop in future years.

Varieties

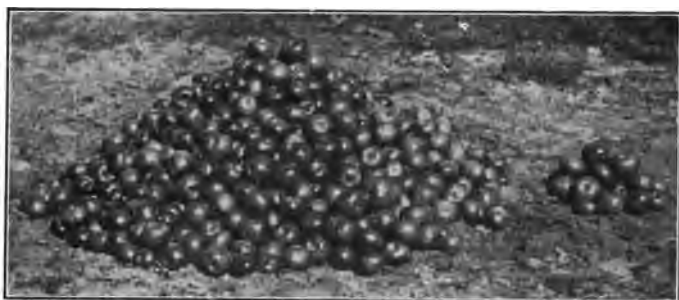
About one thousand varieties of Apples are known in North America. Less than a score of these form the bulk of the commercial product, but many others have great value in special localities and for home use. In selecting varieties the experience of fruit growers in one's own neighborhood is the most valuable guide, although it is always interesting to experiment in a small way with sorts untried in the locality.

Success in commercial Apple culture lies in choosing the right location and varieties, giving good tillage, fertilizing properly, taking care to furnish plenty of

phosphoric acid and potash, but not too much nitrogen, pruning correctly, spraying at the proper times and with the proper mixtures, harvesting and packing carefully, and selling to best advantage. Each of these operations requires knowledge and skill of a high order.



Uns sprayed: Poor Apples at the Right



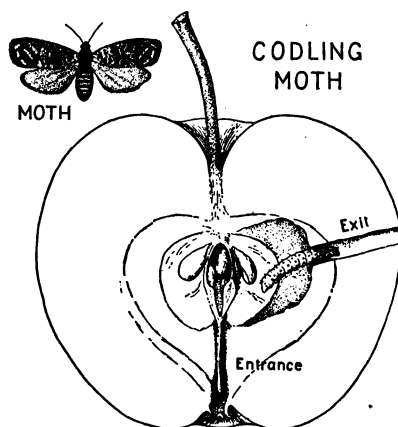
Sprayed: Poor Apples at the Right

RESULTS OF A SPRAYING TEST

Apple Enemies

Many leaf-eating caterpillars attack apple foliage. The Canker-worms are among the most destructive of these pests. The eggs of the Fall Canker-worm are laid in autumn and remain unhatched through the winter.

The eggs of the Spring Canker-worm are laid in spring. The larvae of both species hatch as the buds are opening and attack the young leaves, often doing great damage. They are looping caterpillars or measuring worms. When fully grown they change to pupae at or near the soil surface. The female moths are wingless. Spraying with arsenate of lead before the blossoms open and after the petals fall will destroy these pests.



In some parts of New England the Brown-tail Moth and the Gipsy Moth are exceedingly destructive to apple orchards. In New York and other regions the Bud-moth Caterpillars and Case-bearers are injurious. In most eastern and middle western states the Apple Tent-caterpillar

is often destructive. These pests may all be controlled by spraying with arsenate of lead.

Enemies of the Fruit

The Codling Moth or Apple Worm is one of the most generally injurious insects affecting apple fruits. The eggs are laid by a small moth, usually upon the green fruit or the leaves. They hatch into whitish worms that burrow into the young apple and feed upon the pulp

for several weeks. When they are full grown in this larval state they leave the apple and each spins a cocoon under such shelter of loose bark as it can find. Then it changes to a pupa, to change again in about two weeks to a moth. There are usually two broods each year, the insects passing the winter as larvae within the cocoons.



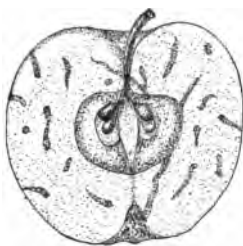
FOUR APPLES INJURED BY CURCULIOS: ONE UNINJURED

The larvae of the Codling Moth may be killed to a great extent by spraying the trees with arsenate of lead just after the petals fall, when the calyx cups are still open. It is desirable to force the poison into the cups by using high-pressure pumps that give a forceful spray. One or two later sprayings are helpful, but not necessary.

The Plum Curculio often attacks apples. The female beetles cut crescent-shaped marks in the skin of the young fruit in order to deposit their eggs. The larvae are commonly unable to develop in the apple, but the injury done by the beetle causes the fruit to be gnarled and one-sided. Fortunately the poison applied to kill

the Codling Moth larvae is also largely effective against the adult curculios.

The Apple Maggot or Railroad Worm is a serious pest in many regions. A small fly lays eggs beneath the skin of young apples in summer.



CHANNELS OF
APPLE MAGGOT

The eggs hatch into footless maggots that burrow through the pulp. The injured fruits finally fall and the maggots leave them to enter the soil. Here they pupate and remain until the following season, when they emerge as flies. The usual spraying with arsenate of lead is helpful against the pest,

as is the picking up of windfalls or pasturing with stock that eats them.

Scale Insects

Three species of Scale Insects or Bark-lice commonly attack apple trees. The San José Scale is most destructive; the Oyster-shell Scale next and the Scurfy Scale next. The Oyster-shell Scale is easily recognized through its resemblance to miniature oyster shells. The eggs beneath the scales in winter may easily be seen even with the unaided eye. The Scurfy Scale occurs as small whitish patches scattered over the bark. All these scales are killed by the thorough application of the lime-sulphur spray to the leafless trees.

Apple trees, especially when young, often suffer from the attacks of Rabbits and Meadow-mice. These pests feed upon the bark of the trunk near the ground, frequently girdling it so completely that the tree dies.

Painting with white lead and pure raw linseed oil, smearing the bark with the lime-sulphur wash, or covering it with wire netting are efficient means of preventing such damage.

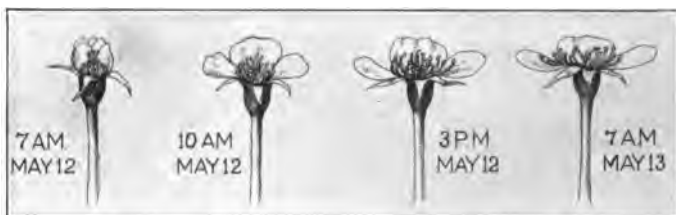


OYSTER-SHELL SCALE

Apple Scab

Apple Scab is the most important fungous disease attacking this crop. It is due to a parasitic fungus that develops upon both leaves and fruit, causing brownish discolorations on the former and black, woody patches on the latter. It causes the loss of millions of dollars worth of apples every year. It can be prevented by means of dilute lime-sulphur spray, which is preferred to Bordeaux mixture because it causes no damage to the fruit.





POMACEOUS FRUITS: THE PEAR

Varieties

Teacher and pupils should arrange a little exhibit of varieties of pears. Get the real fruit whenever possible, helping out with wax models and colored pictures, if available.

Learn what varieties are grown locally and make lists under these headings:

SUMMER

AUTUMN

WINTER

Pear Blight

Examine pear trees for blighted branches. On neglected trees these are likely to be found at any season. Even in winter such branches may be known by the dead leaves still hanging to the twigs.

Cut off and burn all such diseased branches.

Fungous Diseases

Keep watch for pear leaf-blight on leaves and fruits, especially late in spring and early in summer.

Find spots due to scab upon pears. Compare its appearance with apple scab.

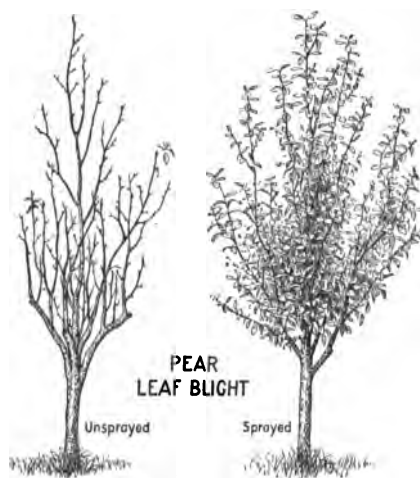
Inquire whether pear trees sprayed with fungicides are injured by these diseases — leaf-blight and pear scab.

Insect Enemies

Look for pear leaves which have had the surface eaten off, leaving the network of veins to show. In summer the little pear slugs that do the damage are likely to be found.

See if you can find pears showing the crescent marks of the curculio; or those infested by codling moth larvae.

Look for bark-lice or scale insects on pear trees.



THE PEAR

The Pear appears to have been one of the earliest fruits cultivated by man. The wild species, called *Pyrus communis*, is native to Asia and Europe, and its fruit, or that of cultivated varieties derived from it, has been prized since long before the dawn of recorded history. The great majority of the cultivated varieties now grown in Europe and America are direct descendants of this species.

Another species of Wild Pear, called *Pyrus Sinensis*, is native to China, whence it has been widely distributed over the earth. It is known as the Sand Pear, Chinese Pear, and Japanese Pear. Its fruit is of little value as compared with the other type, but the tree is of a decided ornamental appearance and has been cultivated for landscape garden purposes. During the nineteenth century Peter Kieffer, a Philadelphia nurseryman, originated a hybrid between this Sand Pear and the European Pear which was introduced as the Kieffer and proved a very valuable sort for commercial growers. Another valuable hybrid of the same sort has been introduced since as the Leconte Pear.

So it happens that the great majority of our cultivated varieties of Pears belong to the European species, while a very few are hybrids between that species and the Sand Pear. The fruit of the former is of better quality, but the trees of the hybrids are more vigorous and able

to stand more trying climates. The hybrids have made commercial pear growing possible in southern regions where it had been impracticable with the older sorts.

Culture and Varieties

There is no such demand for Pears as there is for apples, and the commercial production of the former is of far less importance than that of the latter. But in certain regions Pears are grown on a large scale with profit, and in most places where the fruit trees thrive they should form an important feature of all home orchards. Pears are valuable for dessert and preserves, and by growing several varieties the season can be extended from midsummer to midwinter.

Pear trees thrive and live longest on a moderately rich clay soil that induces a steady but not too thrifty growth. Two-year-old trees are desirable for planting, at distances of twenty feet each way. The young trees should be so pruned as to induce a low spreading top that will protect the trunk from sun-scald. Wood ashes and other fertilizers with little nitrogen are to be preferred to those rich in nitrogen, as this element induces a rapid soft-wooded growth that is commonly thought to render the branches more liable to the attack of Pear Blight than branches having a slow, hard-wooded growth.

Most varieties of Pears when grown as standards come into bearing slowly, a truth expressed in the old couplet

Plant pears
For your heirs.

But when Pears are budded on quince stocks they are

dwarfed and come into bearing earlier. Dwarf pears are particularly desirable for planting in the home grounds where the space is limited. They have to be pruned back every year after they have become well established, and the fruit should be thinned radically when they first begin to bear.

Pollination and Picking

Many a man has planted one or two Pear trees, or several of one variety, and has seen them grow and blossom but bear no fruit. So he has concluded that Pears were not adapted to his locality, when the trouble was due to the fact that the flowers of most Pears, like those of many plums, are self-sterile to their own variety. Consequently it is necessary to plant near together trees of different sorts that blossom at the same time so that the bees and other insects may cross-pollinize the flowers. This will lead to the fertilization of the ovules and the setting of an abundant crop of fruit.

A day's changes in one of the flowers are represented in the drawings reproduced on page 126.

The quality of most fruits is best when they ripen upon the tree, but in the case of the Pear the best quality is obtained when the green fruit is picked as it reaches its full size and is carefully stored in a cool place to ripen. In the case of the winter varieties it is worth while to wrap each fruit in paper and store it carefully in a cool cellar where the temperature varies little.

Pear Blight

Pear trees are subject to attack by many pests: bacteria, fungi, insects, mice, and rabbits all find some part

of the tree to their liking. The most destructive of these enemies are the tiny bacterial germs that cause the dreaded Fire Blight which has done so much damage to Pear trees that it has long been called Pear Blight, though it also affects apples, quinces, and various other trees. This commonly shows its presence by the sudden blackening of leaves or blossoms or both, the whole twig appearing as if scorched by fire. It affects also the fruit and the bark.

On the bark of the trunk and larger branches Pear Blight produces dead cankered spots, around the margins of which the germs often develop in the exuding sap in enormous numbers. Wasps and flies are attracted to this sap; they get the germs upon their mouth-parts and feet so that when they visit the flowers they leave some germs upon the sticky stigma or in the liquid nectar in the nectar cup. Either situation is favorable to the increase of the blight bacteria; they multiply enormously and go down from the blossom to the branch, destroying the live tissues as they go.

When the Blight germs have thus begun to develop in some blossoms they are very likely to be carried to others by the bees that visit the flowers. So these insects may serve to spread infection while engaged in their useful work of pollen distribution. Plant lice or other sucking insects that develop upon a blighting twig or leaf may also carry the germs when they move to new feeding places. Even man may unwittingly spread the disease with his pruning tools, unless he is careful to disinfect them after using them on diseased branches.

The prompt cutting and burning of all diseased parts, with weekly inspections during May, June, and July, and

the disinfection of all wounds by a dilute solution of formalin or corrosive sublimate are the only known remedial measures. The early destruction of suckers and water-sprouts on trunk and large branches is desirable to prevent the disease from establishing cankers on the main part of the tree.

Fungous Diseases

The Pear Leaf-blight is a disease entirely distinct from the Pear Blight. It is confined to leaf and fruit and does not attack the twigs or bark. It is caused by a fungus that infests the young leaves in spring, producing small reddish spots on the upper surface. These spots grow larger with the development of the fungus, sometimes running together to form large blotches. Badly infested leaves drop off, so the tree may be completely defoliated. When the fruit is attacked it commonly breaks open in a way suggestive of the effect of Pear Scab. The disease may be controlled by spraying with fungicides.

Various other fungous diseases trouble the pear as a rule locally, though one, the Pear Scab, is widely distributed. In character and life-history this is much like the apple scab and may be prevented in a similar way. Most diseases of apples are liable to appear upon Pears, but fortunately proper spraying checks their injuries upon both fruits.



Insect Enemies

The Pear is also subject to attack by many insect pests; the Codling Moth, the Plum Curculio, and the San José Scale have life-histories on pears very similar to those upon apples. Various borers and bark-beetles also attack pear trees as they do apple trees. The leaves are fed upon by the Pear Slug, a small two-brooded insect that is readily killed by spraying with arsenates.

The Pear Psylla is a small insect that is sometimes locally injurious. It is a tiny creature, related to the aphides. It winters over as an adult, often in the shelter of loose bark. In early spring the female Psyllas lay their eggs on or near the buds and these eggs hatch into little Psyllas that suck the sap from the stalks of the developing leaves. These become full grown in early summer and lay eggs for a second brood, which in turn is followed by other summer broods, throughout the season. Spraying as soon as the blossoms fall with dilute kerosene emulsion or a solution of whale-oil soap is an effective remedy.

Vertebrate Enemies

Meadow-mice seem particularly fond of the bark of young pear trees. Under the protection of the snow they frequently strip off practically all the bark for a foot or two above the ground. The best way to prevent such damage is to enclose the trunk in wire netting of a mesh small enough to prevent the gnawing or else to paint the trunk with white lead and raw linseed oil. Injury by rabbits will also be prevented by either method, if the protection extends far enough up the trunk.



STONE FRUITS: THE PEACH

Varieties

If the peach is grown locally learn what varieties succeed best.

If the peach is not grown locally learn whether a few trees have not succeeded in past years. In many places peaches could be grown for home use where none are now planted.

Peach Diseases

Learn whether any of these diseases are destructive to peaches locally:

Peach Yellows	Peach Leaf-curl
Peach Rosette	Brown Rot

Inquire whether orchards sprayed with lime-sulphur solution are badly injured by leaf-curl and brown rot.

Find mummied peaches on the trees. Bring some to school and place under an inverted tumbler on a pane of glass. Keep moist and see the development of the spores in velvety masses.

Each pupil should remove such mummied peaches on trees at home.

Insect Enemies

Examine peach trees for signs of borers. Dig out all that can be found.

Examine the bark to see if any scale insects are present.

After the fruit sets examine the young peaches for the crescent marks of the plum curculio. If they are abundant it may be advisable to jar the trees and catch the curculios on sheets spread beneath.



THE PEACH

By general consent the Peach ranks as the most luscious of tree fruits. Like the strawberry — the most luscious of small fruits — its season is comparatively short and the melting quality of its flesh prevents it from being kept long, even in cold storage. The fact that areas adapted to Peach growing are restricted on account of the tenderness of bud and tree to frost and cold also helps to make the fruit a luxury for the summer season, though fortunately the fruit is easily preserved and forms an important feature of the canned fruit industry.

While five rather distinct types of Peaches are grown in North America, most if not all of them are believed to have been derived from the Peach of history — a tree grown from time immemorial in Persia, and probably existing originally as a wild species in China, Asia, or other regions. Most of the varieties in the United States are of the Persian type grown in Europe for centuries, but a few like the pointed Honey Peach and the flat Peen-to Peach, which are grown locally in the south, have come directly from China in recent years. Special interest attaches to the Candler and some other varieties grown commonly in the south: these are derived from wild peach trees found when the southwestern states were settled by the colonists from the eastern states. These wild trees are believed to have originated

from European peach trees brought to Mexico or other regions on the Pacific coast, by the Spaniards at the time of their early invasions, several centuries ago.

Site and Culture

The Peach is a comparatively short-lived tree, but it is easily propagated and begins to bear early. It is grown from seed, the little seedlings being budded within a year of their sprouting and the trees being planted in their permanent situation within a year of the time they are budded. Light sandy loams are the best soils for growing peaches, but great care must also be taken in the selection of the site. Peaches are subject to winter killing of trees and fruit buds by too low temperatures and the buds and blossoms are subject to destruction by frosts. Consequently the site must be one where the winter temperature is not too severe and yet where the spring warmth will not force the trees into blossom so early that the opening buds will be blighted by frost.

The areas in the United States especially favorable to peach growing are limited by these requirements. Near great lakes and sounds the winter climate is tempered by the water, so that the winter is not so cold nor the summer so hot, while spring comes on with moderation. So it is natural that the Peach should flourish in such regions, and we find great Peach orchards in southern Michigan, northern Ohio, western New York, in Delaware, Connecticut, and along the coast southward.

In southern regions the winter climate is not severe, and in elevations of a thousand feet or more the spring comes more slowly than at sea level. So we find more Peach orchards flourishing in the higher parts of Georgia,

Alabama, and the Carolinas. In many parts of California, Peaches are also grown on a large scale, much of the fruit being preserved by drying.

Peach Pests

The Peach is a tender tree: it grows rapidly and its wood, bark, leaves, flowers, and fruit are all delicate in structure as compared with most other fruit trees. So it is not strange that it is subject to injury from many enemies, especially parasitic fungi and insects of several kinds. The precise causes of two of the most destructive diseases, however, have yet to be determined. Peach Yellows has caused the destruction of numberless orchards, and the Peach Rosette in certain southern states has been locally injurious. Both are known to be contagious, but the organisms producing them have not yet been isolated.

Peach trees affected by the Yellows disease send out slender yellowish shoots very early in spring, these sometimes taking on a brush-like appearance because so many grow in a cluster. Later in the season the fruit ripens prematurely, is of inferior quality, and bears characteristic red spots on its surface, the red marking extending into the flesh. While only a branch or two may be affected at first, the disease spreads until it kills the whole tree. No remedy is known, the only treatment being to remove and burn the tree, root and branch, and set a new one in its place. Fortunately the disease does not inoculate the soil so that the new tree is in no greater danger from Yellows than the trees set in other places in the neighborhood.

Peach Rosette appears to be a sort of acute form of

the Yellows disease. The whole tree may seem to be affected suddenly, sending out rosettes of short and slender twigs from all its branches, each twig being crowded with small yellowish leaves. Such trees soon die, and the only thing for the orchardist to do is to cut and burn them promptly.

Fungous Diseases

The Peach Leaf-curl is a vexatious disease that often causes the defoliation of the trees in spring. The young leaves become strangely curled and swollen before they fall off. The crop for the season is ruined in cases of severe attack. The disease is local as a rule and rather uncertain in its appearance, but is especially destructive during wet springs. Fortunately this Curl can be easily prevented by thorough spraying with lime-sulphur wash or Bordeaux mixture during the dormant season and before the buds swell. The lime-sulphur spray has the additional advantage that it destroys the San José Scale.

The Brown Rot of Stone Fruits has been the most generally destructive disease in Peach orchards. The annual loss on this fruit alone caused by this fungus has been estimated at three million dollars. In addition to the damage done the fruit on the tree and after packing, the blossoms are destroyed, especially during wet springs. The removal of the mummied peaches upon and beneath the trees and spraying with dilute lime-sulphur washes are effective remedial measures.

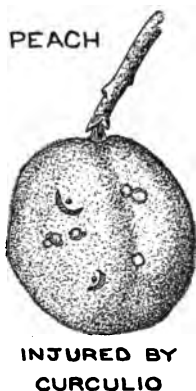
Many other fungous diseases affect the Peach. The Peach Scab is a serious and widespread malady of the

fruit, shown by black specks or blotches upon the skin, the injury extending to the adjacent part of the fruit. Several other fungi attack the leaves, causing shot-like holes or other injurious effects. The bark is attacked by others and the roots commonly suffer from the vexatious Crown Galls that attack so many plants. Special care should be taken not to plant any trees showing the characteristic galls of this disease.

Insect Enemies

Peach trees are almost as subject to insect attack as they are to those of parasitic fungi. Root, trunk, bark, twig, leaf, and fruit — each is infested by one or more insects. The Peach-tree Borer is probably the most generally destructive of these pests. The adult insect is a small clear-winged moth that deposits eggs on the trunk near the ground. The eggs hatch into whitish larvae that burrow beneath the bark, often going toward the roots. They cause a gummy exudation at the surface of the holes which is a sign of their presence. After nearly a year of growth they change to pupae, to change again a little later into moths. The trees should be carefully examined in early summer and in autumn and all borers dug out.

The San José Scale is especially destructive to Peach trees. The infested bark becomes covered with a grayish crust of scales, the insects multiplying so rapidly



as soon to kill the tree. Winter spraying with the lime-sulphur wash will destroy the pests, although when trees are badly infested it is generally necessary to prune back severely before the spray is applied.

Peach fruits are commonly attacked by the Plum Curculio. When the insects are abundant it is necessary to spray or to resort to jarring on sheets or Curculio catchers to destroy them. Peach foliage is very sensitive to injury from arsenical poisons, but is not injured by spraying with arsenate of lead. The Department of Agriculture has demonstrated that the Peach Scab, Fruit Rot, and Curculio may all be controlled by three sprayings with two pounds arsenate of lead to fifty gallons self-boiled lime-sulphur wash, first when shucks are falling from young fruits; second two or three weeks later; third one month before fruit ripens, without lead arsenate in the latter case.





STONE FRUITS: THE PLUMS

Varieties

Learn what varieties of plums are grown locally. Arrange the variety names under these headings as far as possible:

DOMESTICAS	JAPANESE	AMERICAN	HYBRIDS
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Time of Blossoming

Learn when all the different varieties of plums grown locally blossom. Keep a record of the varieties that blossom at the same time, as these are generally cross-pollenized by bees and so should be planted near together.

Fungous Diseases

Find black knots on plums, and wild and cultivated cherries. Burn up all that can be seen and make it the business of the school to help exterminate this disease in the district.

Find on the trees dried plums mummied by brown rot. Place one under a tumbler inverted on a pane of glass. Add a little water and see the velvety spores that are likely to develop.

Pick off all the mummied plums on the trees and rake up those under the trees. Burn.

Plum Curculio

Find green plums that show the crescent marks of the curculio.

Cut open fallen plums to find the curculio larvae.

Place fallen plums in a jar with a few inches of soil in the bottom. See if you can find pupae in the soil later.

Jar plum branches over a sheet and catch some of the adult curculios.



THE PLUMS

The Plum is justly esteemed one of the most delicious of fruits. When fresh it is excellent for eating raw, for sauce, and for jelly. It is easily canned and when dried the prunes made from certain plums form one of the most important of fruit products. So many types of plums exist that they can be grown in almost any region and the fruit ripens over a very long period.

The Plum of literature and tradition is the European or Domestica type — the *Prunus domestica* of the great botanist Linnaeus. The fruit has been grown for so many centuries that it is not known just what wild sort it was originally developed from, though it probably was a wild tree in Asia. This is still the type most generally grown in America, especially in the Eastern and Pacific coast regions, where the climate is not so severe as to prevent its successful growth. These plums have been grown so long, however, and under such varying conditions that remarkable variations have been developed, each type of variation being represented by several varieties.

Classification

The types of Domestica Plums have been grouped in five distinct classes by Bailey, namely:

1. THE PRUNES. These are Plums which have so much sugar in their composition that they can be dried

successfully. California and other Pacific Coast states grow these varieties in enormous quantities, leading the world in prune production. About the year 1900 it was estimated that 150,000,000 pounds a year were produced in this region. Most prunes are made from dark colored plums, but improved sorts of light colors are now coming into use.

2. **THE DAMSON PLUMS.** These are small blue plums formerly very popular for sauce and preserves. They were grown largely around the homes of the early settlers and have become wild in many localities. They are pictured on page 143.

3. **THE GREEN GAGE PLUMS.** These are rather small plums, green or yellow green when ripe. They are of excellent quality for preserves, but are less grown now than formerly. Reine Claude is typical of this group.

4. **THE YELLOW OR GOLDEN PLUMS.** These are distinguished by their large size and yellow color. They include some good varieties, such as Coe's Golden Drop.

5. **THE PURPLE PLUMS.** These are the well-known plums, like the Lombard, having red, blue, or purple skins, and of medium or large size. A large proportion of the commonly grown varieties belong to this group.

Culture and Enemies

The Domestica Plums are most successful on a comparatively heavy soil, although they may be grown to advantage under a great variety of conditions. When grafted upon the peach they succeed in sandy soils. In the great regions adapted to their growth climatically they are justly favorites in home gardens as well as in

commercial plantations. The trees should be set from fifteen to twenty feet apart according to the variety. Two-year-old trees are the best to plant. The young trees should be severely pruned back before setting. Careful culture or heavy mulching should be given the young plantation, together with plenty of plant food, especially that rich in potash.

Many varieties of plums will not set fruit unless the blossoms are cross-pollinated by another variety. This is a common reason for failure with the crop. It is easily avoided by planting two or preferably more varieties near one another, so that the bees and other insects may carry the pollen from tree to tree. These must be sorts, however, that blossom at the same time. In general it is worth while to grow at least a few trees of several sorts in order to be sure of abundant cross-pollination.

The Domestica Plums are subject to many attacks by insects and fungous diseases. Unless constant watch is kept for Black Knot, San José Scale, Fruit Rot, and Curculios the trees are likely soon to become worthless. But these enemies can be controlled and their existence makes the plums even more valuable to the intelligent fruit grower.

JAPANESE PLUMS

In 1870 a fruit grower in California imported some plum trees from Japan. A few years later the trees began bearing good crops of attractive fruit, so different from the other plums in cultivation that it seemed worth while to propagate the variety. So about 1883 a firm of California nurserymen began selling the trees, naming

the variety the Kelsey, after the man who owned the original trees. Seedlings from these original fruits were grown and other importations from Japan were made, so that a few years later several varieties of Japanese Plum trees were upon the market.

These Japanese Plums differ decidedly from the Domestic types. Their technical name is *Prunus triflora*. In manner of growth and appearance of foliage they are suggestive of peach trees. They grow very rapidly and begin bearing early. The flowers appear so early in spring that they are often in danger from late frosts. The blossom buds are clustered beside the leaf buds and the fruits are borne in such thick clusters along the branches that thinning is generally necessary to get plums of large size.

Both color and quality of the fruits vary greatly, some sorts being red, others yellow. Some are good for dessert or canning and others are poor in quality. The trees vary greatly in hardiness also, some kinds enduring



BURBANK PLUMS

the severest winters of the extreme northern states, where others have their fruit buds easily killed by freezing. So the selection of varieties with respect to their adaptation to special purposes and to local conditions is very important with these fruits.

The Japanese Plums have been especially important in the origination of new varieties by crossing with other sorts. Very

remarkable results have been obtained by Luther Burbank in California, who has produced many new plums through hybridizing the Japanese with other kinds. Nearly a hundred Hybrid Plums, largely of Japanese origin, are now known and new ones are frequently being introduced. Some of the most promising varieties of plums are found in the list of hybrids. Among these the varieties called Apple, Climax, Golden, Maynard and Occident or Sultan deserve special mention.

AMERICAN PLUMS

The third important group of plums are the various American types. These are seedlings or hybrids of the several species of wild plums, native to various parts of North America. They are specially valuable because of their hardiness, which adapts them to climatic conditions under which the European and Japanese varieties cannot be grown. Botanically



RED JUNE PLUMS

these American plums are much confused because many of them are natural hybrids. For convenience they are divided into certain groups, of which the most important are the Wild Plum of the Mississippi valley region, known technically as *Prunus Americana*, and its northern variety the Canada

Plum (variety *nigra*), the Wildgoose Group, the Miner Group, and the Wayland and Chickasaw groups. Each of these groups has given rise to varieties now or formerly in cultivation, and in general especially adapted to certain regions.

A great many of the Japanese, the Hybrid, and the American Plums are self-sterile, each variety requiring pollination by some other variety that blossoms at the same time. Consequently it is very important in planting the trees to learn if possible by the experience of others in the same locality what sorts help one another in this way. The state experiment station or the national Department of Agriculture can generally suggest such varieties.

While good plums of any sort are especially desirable for the home garden, they also find a ready market in the larger cities. To get the best prices care is needed in culture to insure large size and good quality. One of the best receptacles for marketing plums is the ten pound grape basket, generally used in marketing grapes.

Types of Plums	Domestica or European	Prunes
		Damsons
	Japanese	Green Gages
		Yellow Plums
	American	Purple Plums
	Japanese	Pure Japanese
		Japanese Hybrids
	American	Americana Group
		Canada Group
	American	Wildgoose Group
		Miner Group
	American	Wayland Group
		Chickasaw Group

Plum Pests

Few fruit crops are so beset by enemies as are the plums. Root, trunk, branch, leaf, flower, and fruit are each attacked by insects or fungi or both, too often with disastrous result. Yet the very fact of these attacks makes the plums worth growing, for without these various enemies the fruit would be so abundant as to have little commercial value.

The Black Knot has probably destroyed more plum trees in the past than all other agencies combined. This is a fungous disease which occurs upon wild and cultivated cherries and plums in the form of black, wart-like excrescences upon the bark of twigs and branches. In many regions its ravages are prevented by careful watchfulness.



BLACK KNOT

Black Knot, like other fungous diseases, reproduces by means of spores. These appear in summer as a velvety olive green coating upon the bark of affected branches. They are scattered by wind and rain and when they lodge upon the tender bark of other branches they start the disease anew. Consequently one of the first remedial measures is to cut and burn all Black Knots wherever found to prevent the development of these spores. It is also necessary to keep a sharp lookout all through the summer for the swollen places on twigs and larger branches that indicate new attacks of the

fungus and to cut and burn these promptly. Spraying with fungicides will also prove helpful.

Other Fungous Diseases

The Brown Rot of stone fruits is another serious menace to plum culture. It is the disease that so often causes the rotting of the fruit upon the tree before picking or in the baskets after picking. It is caused by a fungus which produces myriads of spores from the affected fruits, these spores being carried by the wind and starting new centers of disease when they light upon other plums.

Many of the injured fruits hang as shriveled mummies upon the tree through the winter and spring while others remain upon the ground beneath the tree. These develop new crops of spores in spring and summer, these spores often causing the disease to appear upon the blossoms in spring and the new crop of fruit in summer. Consequently the destruction of all these mummied plums is desirable if we hope to check the disease. Then by spraying with the self-boiled lime-sulphur wash serious injury may be prevented.

Young plums are sometimes affected by a curious disease which causes them to become strangely swollen with hollow spaces where the pits should be. The disease is called Plum Pockets: it is due to a parasitic fungus closely related to the one that causes Peach Leaf-curl. The swollen plums often become covered with a powder made up of the spores of the fungus. Then the diseased plums fall off, but threads of the fungus remain in the twigs and grow along with the twigs so that succeeding crops on such branches are very likely to be diseased. Consequently it is desirable to cut off

all branches which bear the swollen plums, and to cut back far enough to get rid of the fungus threads in the tissues of the twig.

The foliage of both plum and cherry trees is often seriously injured by Leaf-spot, a fungous disease which first appears in the form of small discolored spots, generally purplish in color.

These spots soon turn brown, and when the spots are numerous the leaves become yellow and drop off. When not so numerous as to affect the whole leaf the little brown circles sometimes drop out, leaving holes looking as if small shot had been fired through the leaf. On this account the fungus is some-



PLUM POCKETS

times called the shot-hole fungus. The disease may be prevented by spraying three or four times with the self-boiled lime-sulphur wash.

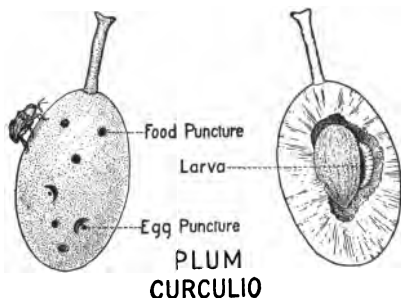
Insect Pests

Many insects attack plum trees occasionally, but one pest must always be taken into consideration — the Plum Curculio. This is a small beetle that occurs practically everywhere that plums are grown and appears practically every season to prey upon the fruit. Occasionally a few years will pass when it is so scarce that it does little injury and on large plantations it often happens that there are so many more plums than Cur-

culios that the latter are a positive benefit in thinning the fruit. But in the home orchard the Curculio needs looking after if an adequate crop is to be gathered.

The adult Plum Curculios appear on the trees in early spring about the time that the buds open. They feed upon the young leaves awhile and remain until the blossoms have come and gone and the fruit has set.

Then they nibble little cavities in the green plums for food and make characteristic crescent-shaped marks in the skin in depositing their eggs in the green flesh of the young plums.



These eggs soon hatch into little grubs that feed upon the pulp and render the fruit unfit to ripen. So it falls to the ground, the grub crawls out and finds shelter in the soil. Here it changes to a pupa and a few weeks later changes to an adult beetle that lives until the following spring. This insect attacks cherries, peaches, and apples as well as plums.

In orchards the Plum Curculio can be killed off largely by spraying with arsenates. In smaller plantings it is often necessary to jar the trees early in the morning, catching the beetles that fall by first placing a sheet on the ground beneath the trees. Curculio catchers are often made by spreading sheeting over a frame with one or more wheels attached. The Curculios thus caught are of course destroyed.



STONE FRUITS: THE CHERRIES

Varieties

Let pupils tell where there are sweet and sour cherry trees growing in the district.

How do the two trees differ in manner of growth?

See how much can be learned about the names of the varieties of each type that are grown successfully. Make a temporary blackboard list under these headings:

SWEET OR MAZZARD

SOUR OR MORELLO

Enemies

Make a map of the district and mark on it every locality where pupils find that black knot is growing on wild cherries, cultivated cherries, or plums.

Get each pupil to agree to destroy the black knot on his own farm or home grounds.

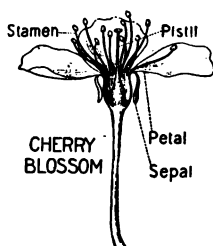
Request the highway commissioners to destroy it along the highways.

See if the school cannot make its influence felt in this one campaign against black knot.

Let teacher and pupil feel that every black knot to be seen in the district is a reflection on the efficiency of the school.

Whenever the knot is eradicated from a locality mark off the place in red.

Be sure that all knots are burned.



THE CHERRIES

Commercially the Cherry is one of the least important of the Stone Fruits, the product being of decidedly less value than peaches or plums. There are, nevertheless, enormous quantities of Cherries grown for home use and in a few regions the fruit is grown for canning factories or for market.

The many varieties of cultivated Cherries are readily classified into two great groups — the Sweet Cherries and the Sour Cherries. The Sweet or Mazzard Cherries are all derived from a tree native to Europe and Asia called by botanists *Prunus avium*. The Sour or Morello Cherries are all derived from another tree, also native to Asia and perhaps to Europe, called by botanists *Prunus cerasus*. Both of these trees have been in cultivation for a long period and have run wild in many parts of the United States.

Sweet Cherries

The Sweet or Mazzard Cherry tree grows erect with a main central stem beside which the branches run in a nearly vertical direction, giving the trees a pyramidal appearance which is especially marked when they are young. The wild seedlings are abundant in the Atlantic states and are commonly called Mazzard Cherries. These Mazzard seedlings are largely used as a stock on which to graft the various sorts of both sweet and sour

cherries. The fruit of these is inferior to the cultivated sorts, of which there are three principal types, namely: the Hearts, the Bigarreaus, and the Dukes. These three types are characterized thus:

Hearts: fruit sweet, soft, heart-shaped, as in Black Tartarian.

Bigarreaus: fruit sweet, firm, heart-shaped, as in Napoleon.

Dukes: fruit rather sour, as in May Duke.

Sour Cherries.

The Sour or Morello Cherry tree grows in a low spreading manner that at once distinguishes it from the Mazzard type of tree. The trunk breaks up into several branches without a main central stem and these branches grow outward horizontally rather than upward vertically. Wild seedlings are abundant in many regions where Cherries have been grown for a long period, and these seedlings often occur in thickets because the trees send up suckers freely from the roots. When well treated such seedlings often yield excellent fruit. There are two types of Sour Cherries, namely:

Amarells: fruit round, with skin light red, juice colorless, as in Early Richmond.

Morellos: fruit round, with skin and juice dark red, as in English Morello.

Cherry trees thrive in a light, loamy, well-drained, and fairly rich soil in regions where the air is not too dry. Consequently it is a crop for northern and coast regions rather than the great plains areas. The Sour Cherries are hardier and adapted to a wider range of soil and climate than the Sweet. One or two-year-old trees are

planted and all varieties should be so pruned as to make low spreading heads, an easy process with the Sour type but more difficult with the Sweet. The possibilities of profit from commercial planting depend very largely upon the accessibility of a good market.

Enemies

Cherry trees are particularly liable to destruction by Black Knot, caused by the same parasitic fungus that attacks the plum. This is the main reason for the disappearance of the cherry trees on thousands of home grounds. A constant watch for the first signs of the disease—shown by the swelling of the bark—should be kept and such injured parts immediately be cut off and burned. All wild cherry or wild plum trees that show the Knots in the neighborhood should also be burned and united action be taken by the whole community to suppress the disease.

The cherry is subject to much the same injury by Leaf-spot and Brown Rot that the plum is. The Leaf-spot is often injurious to young trees and in moist climates is frequently supplemented by the Cherry Powdery Mildew, which causes the leaves to curl up and drop off. The Brown Rot is usually less destructive than on plums because the cherry fruits do not touch one another as the plums often do. Spraying with the lime-sulphur wash is helpful in preventing all of these diseases.

The Plum Curculio also attacks cherries and sometimes causes the loss of much of the crop. In large plantations the injury may be prevented to a great extent by spraying with arsenate of lead, but where the attack is severe upon a few trees the jarring method

should be employed. The leaves of cherries are often injured by the Cherry Slug, pictured below, which is easily killed by dusting air-slaked lime or other powdery materials over the tree, or by spraying with hellebore or arsenate of lead. The young leaves are also attacked by the Cherry Aphis, a pest to be destroyed by early spraying with dilute kerosene emulsion or some form of tobacco decoction.





SMALL FRUITS: THE GRAPE

Varieties

Learn what varieties of grapes are grown in your district. Make a list of the good qualities of each as indicated by these headings:

Earliness of ripening

Hardiness in living over winter

Size of berries

Size of clusters

Freedom from disease

Fungous Diseases (Summer and Autumn)

Let pupils look over grapes on their home grounds. If some of the berries are shriveling and turning black they are probably affected with black rot.

Look also for a whitish mildew on the leaves and young grapes, with a more or less powdery effect. This is the powdery mildew.

Learn whether vineyards sprayed with Bordeaux mixture suffer much from these diseases.

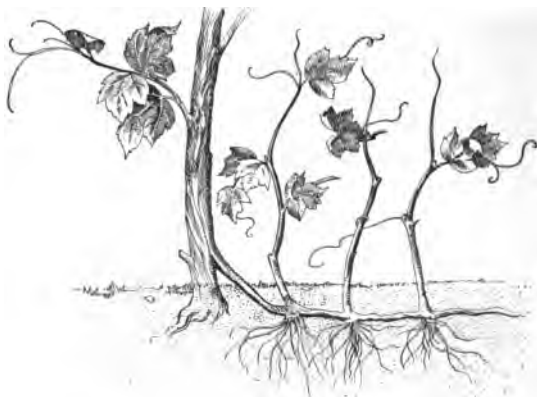
Just after the fruit sets tie paper bags over some of the clusters, and leave on till the grapes are ripe.

Insect Enemies

Look for grape leaf hoppers on the leaves. Find the different stages. See how they get their food.

Look also for grape-vine flea-beetles. See how they differ from the leaf hoppers.

Find clusters of green grapes attacked by the larvae of the grape-berry moth. See the whitish worm that does the damage.



THE GRAPE

The Grape is one of the most generally grown of the small fruits. One or more vines are to be found in the home grounds of most Americans in village and country. In certain sections where climate and soil are especially favorable, extensive vineyards produce great quantities of the fruit for market. There are so many varieties that the Grape is adapted to a wide range of climate and can be grown with profit from Maine to Texas.

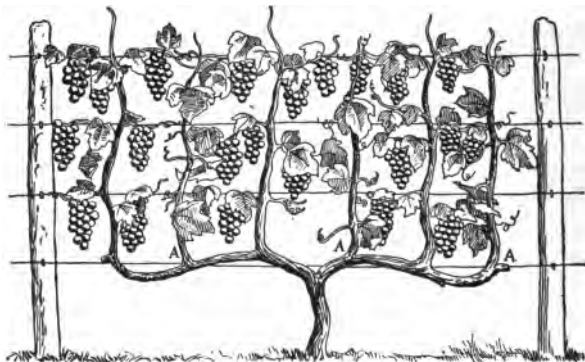
Grape vines may be grown successfully in a great variety of soils, but they thrive best in a deep, porous, well-drained, sandy loam. If the soil is too rich in nitrogen there is a growth of vine at the expense of fruit. So care should be taken to fertilize only moderately, especially with regard to nitrogen. If the soil is acid, lime should be added and in warm climates especial care should be taken to see that the roots can go deep enough into the subsoil to escape the parching heat of summer.

Early spring is the best time for planting grapes. One-year-old vines are to be preferred to older ones as they make a better start with less checking of their growth. They should be set six to ten feet apart in well-prepared holes. In case of a few plants about the home it is worth while to bury a few pounds of old bones in the bottom of each hole. These will furnish materials for growth to the roots in later years. Before or just after planting, the vines should be severely pruned, cutting

back to two or three buds. Each vine should be set about two inches deeper than it formerly grew.

Pruning

Volumes have been written concerning the pruning of grape vines. There are many different systems of such pruning. They all depend primarily upon the fact that



RENEWAL SYSTEM OF GRAPE PRUNING

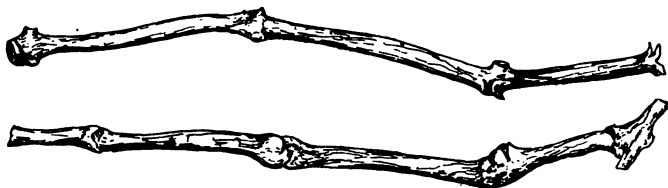
Branches A A A will bear next year

the fruit is borne on the new wood of the same season's growth. Consequently the canes of the previous seasons' growth are cut back to two or three buds, so that the new shoots sent out may have abundant nourishment for the development of a few bunches of fruit. One of the important aims in pruning is so to reduce the number of clusters that the vine will be able to mature them all, without a strain upon its vitality. Another object in pruning is to keep the fruit within easy reach, without the growth of long branches that carry the bearing shoots far away from the roots. Pruning is generally done late in winter shortly before spring growth starts.

The details of pruning depend to a considerable extent upon the method of training adopted. Some vineyardists train to trellises with three wires one above another; this is called the upright system. Others train to trellises with three wires arranged horizontally beside one another; this is called the canopy system. The latter is especially popular in southern regions.

Propagation

Grape vines are easily propagated by layering. In early spring make a shallow furrow three inches deep near a vine in the direction of the rows. Lay a cane of last year's growth along the bottom of this furrow,



GRAPE CUTTINGS

leaving the cane attached to the plant. Peg the cane down with small sticks. After the new shoots that will come from the buds on this cane have grown to the length of six inches, fill in the furrow with soil. Roots will be sent out from the base of each shoot, and a good plant will be thus formed by autumn. This method is especially adapted to home gardens.

The grape is also easily propagated by cuttings. These should be eight to ten inches long, and cut late in autumn from well-ripened wood grown that season. They should be tied together in small bundles and buried in well-drained soil or stored in sand or sawdust, or in a

cool cellar. Early in spring they should be planted outdoors in rich, moist soil, being buried vertically about six inches apart in the row. The soil should be thoroughly tramped down around them so that the bottom of the cutting will be in direct contact with it. A good proportion of these cuttings of varieties that root easily, like Concord and Niagara, make a growth of two or three feet of new shoots during the season. The next spring the young vines are ready for transplanting.

Enemies

Grapes are attacked by many insects and parasitic fungi. Few of the former are so numerous as to be generally destructive every year, although at times some of them become pests over wide areas.

Of the fungi the Black Rot is perhaps the most serious, especially in southern regions. It commonly first appears on the leaves early in summer as small reddish brown spots. A little later similar spots show upon the green grapes. The latter soon rot, shrivel, and turn black, assuming a characteristic appearance. Spraying with Bordeaux mixture prevents this and other grape diseases, although for a few home vines, tying paper bags about the young clusters and leaving them on until the fruit ripens is a simpler preventive.



SMALL FRUITS: CURRANTS AND GOOSEBERRIES

Characteristics

In what ways can you tell gooseberry bushes from currant bushes? In what ways are gooseberry fruits used for food?

Can you learn the names of any varieties of currants and gooseberries grown in your district?

Growing Cuttings

Let each pupil make cuttings of new wood about eight inches long in autumn. Tie in bunches and bury in sandy soil until spring.

In spring dig up. See the callus on the cut ends. Plant in rows, six inches apart in the row, leaving two inches of cutting above the ground.

Keep hoed and free from weeds throughout the season. The following spring distribute to the pupils to set out at home.

Insect Pests (Spring)

Watch the lower leaves of currants and gooseberry bushes for eggs and small larvae of currant worms soon after the leaves appear. As soon as small round holes are seen, spray with hellebore or arsenate of lead.

Place a few currant worms in a tumbler and feed with leaves to rear the larvae and see the changes they undergo.

Watch for weak canes in spring. Cut open to see if they are hollowed out by the cane-borer. Remove and burn affected canes.

Fungous Diseases

Find leaves affected by leaf-spot. See how the green part is injured by the spread of the fungus.

See whether spotted leaves drop off before the healthy ones.



THE GROSELLE FRUITS

Currants and Gooseberries are the domesticated types of a great genus of wild plants called *Ribes*. More than a score of species belong to this genus, which is of almost world-wide distribution. Only a few of these species are of economic importance, however, the most notable being those from which our garden Currants and Gooseberries have been derived. The word Groselle, adapted from an old French name, has been adopted to include the fruit-producing forms of *Ribes*, so we may use it when we wish to include both currants and gooseberries.

CURRENTS

The garden Currants, including both the red and the white fruited varieties, have been derived from a wild species found in northern regions practically around the globe. It is called *Ribes rubrum* and is native to Europe, Asia, and North America. The botany books say it is found in "cold woods" and that in America it ranges south to "northern New England, New Jersey, Indiana, and Minnesota." In view of this statement of the home of the wild plant it is not surprising to find that as a successful garden crop the Currant is limited to northern regions, though sometimes it flourishes farther south in mountainous localities.

A deep, moist, rich, loamy soil and a cool climate with only moderate sunshine furnish the conditions

under which the garden Currant thrives, growing vigorously through a long season, retaining its leaves till the end of summer, and producing an abundant crop of good fruit. Without these favoring conditions, the growth is weak, the leaves are shed long before the proper time, and the crop is small in quantity and poor in quality.

In addition to the common Red Currants there are several white varieties derived from the same source. The Black Currants in cultivation are practically all varieties derived from the wild European Black Currant — *Ribes nigrum*. These are much more popular in Europe than in America, for they are seldom grown here.

Propagation and Culture

Few fruit crops are easier to propagate than Currants. This is done by hard-wood cuttings of the newly grown canes. Vigorous canes that have just finished their season's growth are cut into lengths of six or eight inches, tied in bundles of a dozen or more, and buried vertically in sandy soil to an inch above their tops. They are left thus until spring, being mulched with leaves or litter through the winter. By spring the lower end will have healed over by means of a callus and the cuttings may be set six or eight inches apart in rows, being buried so that only an inch or so of the upper end is exposed. These will send out roots and shoots and by another spring be ready to set out as one-year plants.

In establishing the permanent plantation, two-year-old plants are generally set four feet apart, in rows six feet apart. The plants should be inserted a little deeper than they were before, that a good root growth may be

established. In the most northern states they may be set in full exposure to the sun, but farther south it is desirable to choose a partially shaded situation. Good tillage or heavy mulching should be given and liberal applications of wood ashes or other fertilizer rich in potash should be made. The bushes will begin bearing the second season after planting. After that the old wood should be removed occasionally, though care should be taken not to thin out too severely.

Diseases and Enemies

The Currant is subject to certain leaf-spot diseases, which often cause the early dropping of the foliage and a loss of fruitfulness the following season. These are due to the growth of parasitic fungi, which produce small brownish spots that gradually enlarge until they cover most of the leaf, or several may run together to form large blotches. The leaves soon drop off and the storage of food materials by the bush ceases for the season. Sometimes an existing crop upon the vines is unable to ripen, but more often the loss is shown in the smallness of the crop the following season. The choosing of cuttings from the least affected bushes, the burning of fallen leaves, and spraying with fungicides are the best measures of prevention.

The Currant Worm is one of the most destructive garden insects. It is found in most places where currants are grown, and unless poisoned commonly defoliates the bushes. Wintering over in cocoons beneath the bushes, the parent flies appear in the garden early in spring and lay their eggs upon the young leaves. The eggs soon hatch into the worms or larvae that devour

the leaves greedily for several weeks. Then they form cocoons beneath the bushes and change to pupae, soon changing again to the second brood of flies. These



THE CURRANT WORM

Eggs on leaf; larvae eating leaf; adult fly

flies lay eggs for the second brood of larvae, which are often overwhelmingly abundant. Spraying or dusting the bushes with hellebore when the leaves are two-thirds grown is the remedy generally employed.

GOOSEBERRIES

From time immemorial a species of Gooseberry (now called by botanists *Ribes grossularia*) has been growing wild in Europe, Asia, and Africa. The ripe fruit doubtless has been eaten by men for thousands of years, but

it seems that the plants were not cultivated in gardens until about four hundred years ago. Between the years 1500 and 1600 the plants were frequently cultivated in Europe, especially in Holland and England, and various distinct varieties were developed. At a later period the cultivation of the Gooseberry became a hobby with the weavers of Lancashire, England. They had Gooseberry exhibits every year and did a great deal to improve the size and quality of the fruit. Thanks largely to their interest there are now many varieties of these English Gooseberries grown in England and to a less extent in America.

From time immemorial, also, a species of Gooseberry (called by botanists *Ribes oxycanthoides*) has been growing wild in North America, especially in the eastern United States. The ripe fruit had doubtless been utilized by the Indians centuries before the Pilgrims landed at Plymouth, and probably was eaten by both Indians and Whites thereafter. But so far as we know, no one took the trouble to grow these Gooseberry plants in gardens until about 1833, when a seedling was raised from a wild Gooseberry fruit at Lynn, Massachusetts, by Abel Houghton. It proved so valuable that it was introduced as a new variety, and named the Houghton, after the originator. It is still grown, though better sorts have since been obtained as seedlings from it. It is probable that the original Houghton plant was a hybrid, the pollen that fertilized the seed coming from one of the English sorts growing near a wild plant set in Abel Houghton's garden. Many sorts since introduced are also such hybrids.

Thus it happens that we have in America today two

types of Gooseberries — the European and the American, with many varieties of each. The European berries are larger, but have thicker skins and are the poorer in the quality of the fruit. They have the great defect, however, that they are very subject to attack by Gooseberry Mildew, a fungous disease that practically prevents their being grown to any great extent without persistent spraying. Industry and Triumph are the most important of the European sorts now planted in America. In some favored localities they are not much injured by Mildew.

Except in the matter of size the varieties of American origin are better than the European, being hardier and more vigorous and yielding fruit with thinner skins and of better quality. Many of the American sorts are chance seedlings from wild plants, while others are hybrids in which the American characters predominate. The Downing is the most popular sort. It is a seedling of the Houghton and was first grown by Charles Downing in New York state.

Propagation and Culture

Gooseberries are grown from cuttings, although uniform success is not so easy as with currant cuttings. The method is the same in both cases, but the Gooseberry stems do not root so readily. In nursery practice new plants are generally grown by a special system of layering. Well-established bushes several years old are severely cut back in the fall or winter so that a vigorous crop of young shoots will be sent out in spring. Then soil is mounded up around the bush and filled in at the center in such a way that the bases of the young shoots

are buried in a few inches of soil. The shoots send out roots into this soil and when well grown may be cut off below the roots, thus furnishing new plants. American varieties of Gooseberries are also propagated occasionally by means of root-cuttings.

Like the currant the Gooseberry is essentially a northern fruit. It thrives in a cool climate in a rich, moist soil. It is a home garden fruit more than a market fruit, although in the larger cities there is a fair demand for the berries, which are generally picked green. In gardens the bushes can often be kept in good thrift by the use of a thick mulch of grass or coarse litter which will shade the soil, retain moisture, and prevent the growth of weeds.

Enemies

Gooseberries are subject to attack by much the same insect and fungous enemies as the currant, with the Powdery Mildew as an added source of trouble. As already indicated this is seldom noticed upon the varieties of American origin, but is very destructive to the European sorts. This fungus usually appears in spring upon the partially grown leaves and buds, first showing as a sparse, cobweb-like covering. Later it assumes a more powdery appearance because of the development of millions of tiny white spores. The young berries are also attacked, generally being dwarfed and one-sided as they develop. Spraying with a solution of potassium sulphid, one ounce to two gallons, about once in ten days from the time the buds begin to open until the fruit is gathered will prevent the disease. But it is easier to grow the American sorts which are not subject to it.



SMALL FRUITS: THE RASPBERRIES

BLACK RASPBERRIES

See how blackcap raspberries differ from red raspberries.

Learn what varieties are grown in your district.

Mount in your booklet some catalogue pictures of good varieties.

Did you ever see any of the yellow-fruited or the pink-fruited sorts?

How are new plants obtained?

See if you can find canes attacked by the disease called anthracnose.

RED RASPBERRIES

See how the Red Raspberries differ from the Blackcaps.

Learn what varieties are grown in your district.

How are new plants obtained?

THE RASPBERRIES

BLACKCAP RASPBERRIES

The wild Black Raspberry is one of the most abundant and widely distributed of the fruits native to North America. The type species (*Rubus occidentalis*) is found throughout the region north of Georgia and Missouri to Oregon and British Columbia, while a special variety occurs in the Rocky Mountains and on the Pacific Coast.

So far as the records show, the fruit was first brought into cultivation in 1832, when Nicholas Longworth, of Cincinnati, Ohio, found a very promising wild plant which he transferred to his garden and introduced to horticulturists under the name Ohio Everbearing. Nearly twenty years later another promising plant was found wild in New York state and introduced about 1850 as the Doolittle. Since then a great many varieties have been introduced, most of them being chance seedlings that have attracted attention on account of the special excellence of their fruit.

The Black Raspberry is distinguished from other raspberries chiefly by the purplish black color of its fruit and the habit of forming new plants from the tips of the canes as they bend over and touch the ground. Sometimes vines bearing yellow fruit are found. These "sports" have been introduced under such names as Goldencap, Yellowcap, and American White.

Black Raspberries have become important commercial fruits in practically all northern markets and have also been largely utilized for drying. The fact that the berries are fairly firm enables them to stand shipment better than the red raspberries. The evaporated product is on sale throughout the year and has led to the establishment of great plantations in the neighborhood of the evaporating factories. In a single county in New York one thousand tons of dried raspberries have been produced annually.

Culture

Black Raspberries thrive in a deep, rich, loamy soil. On a large scale they are planted in hills five or six feet apart each way and cultivated in both directions by horse power. On a smaller scale and in home gardens they are set in rows about four feet apart, the plants being about three feet apart in the row. The transplanting is best done in early spring. The plants should be set three or four inches deep and gradually covered deeper as the new shoots develop. When thus set rather deep they withstand dry weather better because the roots are further from the surface and the canes being more deeply imbedded in the soil are less likely to be blown over than when the plants are set nearer the surface. All large canes should be cut back severely.

The Raspberry plantation requires frequent tillage to conserve moisture and prevent the growth of weeds. It is especially important to keep out witch-grass or other grasses having a similar habit of growth. The young canes should be cut or pinched off as soon as they reach a height of two feet: they will lengthen some after

this and will send out numerous side branches which will bear fruit the next season. After four or five good canes have started from each hill, any others should be cut out. As soon after the crop is harvested as possible all the old canes should be removed, cutting off as low as possible, and promptly burned to destroy insect and fungous pests.

Enemies

Of the numerous enemies of Black Raspberries the Anthracnose is most generally troublesome. It appears on the young shoots in early summer as small, reddish-purple spots scattered over the bark. These spots increase in size rapidly, their centers becoming grayish white. Each spot is surrounded by a purplish margin. As the weeks go by the spots become larger and more numerous, often running together in long blotches. As both bark and sapwood are affected the supply of sap to leaves and fruit is partially cut off, frequently causing much loss to the crop. The parasitic fungus which causes the trouble reproduces by means of spores that develop upon the diseased spots. Consequently the cutting and burning of the canes as soon as the fruit is picked is an important preventive measure.

THE RED AND THE PURPLE RASPBERRIES

The cultivated Red Raspberries include three rather distinct groups of varieties, namely: (1) those derived from the European Red Raspberry, *Rubus idaeus*; (2) those derived from the American Red Raspberry, *Rubus strigosus*; (3) those derived from the Purple-cane Raspberry, *Rubus neglectus*.

The European Red Raspberry is found wild over a vast

region-in Europe and Asia. Its fruit has doubtless been relished by mankind ever since human beings appeared upon the earth and forms of it have been cultivated for at least sixteen centuries. A great many improved varieties are now grown in Europe and many have been introduced into America during the last hundred years. Most of these, however, have not proved hardy in our climate, so that very few of them are now grown here. The fruit of these European sorts is generally larger and of finer quality than those derived from our wild red raspberry.

The American Red Raspberry is native to the great northern region extending from the Atlantic Ocean west to Arizona and Missouri and north to Alaska. It is generally abundant and as a wild plant yields a fair quality of fruit. Most of the varieties now in cultivation have been derived from chance seedlings that have been brought into gardens and given good culture. These varieties are generally hardy in our climate and have the habit of ripening their fruit during a much shorter period than the European varieties. The latter point is of special advantage in growing for market, as the fruit can be gathered with fewer pickings. Both these types of red raspberries multiply by suckers sent up from the roots. Cuthbert, Turner, and Loudon are three of the best American Red Raspberries.

The Purple-cane Raspberries or the Purple Raspberries are believed to have been derived from a natural hybrid between the Blackcap and the American Red Raspberries. The fruit is of a purplish red intermediate between the colors of the fruits of these two species, and the plants multiply both from the tips like the blackcaps and from root suckers like the reds. As a rule these are

vigorous growers, requiring more room than the American red sorts. Shaffer and Columbia are two of the best Purple Raspberries.

Culture

The Red Raspberries thrive best in a rich, cool, moist, well-drained, loamy soil. On light thin soils they are likely to suffer from drouth before or during the fruiting season, and on soils too moist or too rich in nitrogen they are likely to grow to vine rather than to fruit. New plants are commonly obtained from suckers, though sometimes from root-cuttings. Better plants are obtained from the latter. The plants are set three feet apart in rows about four feet apart. They should be set in fall or very early in spring. Good tillage should be given to prevent the growth of weeds and to conserve moisture. As soon as the old canes have fruited they should be cut out and burned to destroy insects and fungi and to force the growth into the new canes. With free-suckering varieties about half the suckers should be destroyed when hoeing. In the northern states winter protection is often necessary. Summer mulching is desirable in home gardens, especially during the fruiting season.

In addition to removing the old canes after fruiting the only pruning necessary is to keep down superfluous suckers and cut off the canes each spring at a height of about three feet. This causes them to send out side branches and to stand up better than if left unpruned.

Those varieties of Purple-cane Raspberries that form new plants at the tips of the canes are to be treated like the black caps. Those that form new plants from root suckers are to be treated like the reds.



SMALL FRUITS: BLACKBERRIES AND DEWBERRIES

General Characters

How can you tell a blackberry fruit from a raspberry fruit?

How can you tell a blackberry bush from a blackcap raspberry bush?

How can you tell a blackberry bush from a red raspberry bush?

How can you tell a blackberry bush from a dewberry bush?

Learn what varieties of blackberries and dewberries are grown in your district.

Mount pictures in your booklets.

Fungous Diseases

Do you find blackberry or dewberry leaves affected by an orange rust?

Cut off and burn such affected branches.

BLACKBERRIES AND DEWBERRIES

When a ripe raspberry is picked the fruit separates from the receptacle. When a ripe blackberry is picked the fruit remains upon the receptacle. This is the most important difference between the raspberries and the blackberries and dewberries. Both belong to the great genus *Rubus*, the commonly cultivated blackberries representing at least three distinct wild species native to America.

As a cultivated fruit the Blackberry has been known only since about 1840. Various varieties have been introduced since that time, but even yet there are comparatively few of these. The abundance of the wild blackberries, often to be had for the picking, has probably been an important reason why the plants are so little cultivated. Well-grown garden fruit of the improved varieties is, however, greatly superior to the wild blackberries.

Blackberries normally reproduce from true root-suckers sent up around the parent plant. When cut off and transplanted these suckers thrive and new plantations are commonly started with them. Plants also grow readily from root-cuttings, and this method is often used for propagating them. In most northern regions the transplanting should be done in early spring, though farther south it may be done in autumn. The newly set plants should be cut back to a height of five or six inches.

Culture

Blackberries thrive best in a moist, rich soil, though it should not be too rich in nitrogen or canes will grow at the expense of fruit. They sucker so freely that they should be set at least four or five feet apart in the rows and the rows at least six feet apart if horse cultivation is to be given. On bearing plantations the young canes should be cut off each season as soon as they are two feet high. They will then lengthen out a foot or more, and will develop strong buds or branches along their sides. In this way the crop of fruit the following year will be much better than if the canes are left unpruned till fall or spring. The old canes should be cut close to the ground as soon as they have finished fruiting. After cutting they should be promptly burned.

Winter protection by means of a mulch of litter or soil is very desirable for blackberry canes. With tender varieties it is essential at the north to prevent winter killing, the commonest trouble in growing this fruit.

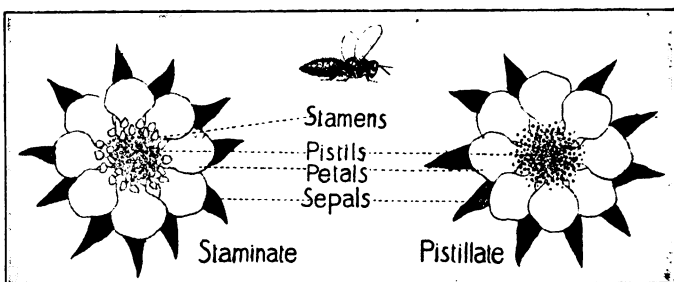
DEWBERRIES

Dewberries are trailing blackberries. Instead of sending the main stalk up vertically it trails along the ground and sends up short fruiting branches. Instead also of propagating by suckers sent up from the roots the dewberries propagate by layers of the prostrate canes. They are of much less importance than the blackberries, but are of value in home gardens, giving a delicious fruit that ripens earlier than the blackberry. The Lucretia Dewberry is the best variety for most fruit-growing regions. On the Pacific Coast the Loganberry, which is closely related to the Dewberry, is a valuable fruit.

Enemies

Blackberries and dewberries are comparatively free from insect and fungous enemies. Leaves and young stems are sometimes attacked by the Orange Rust. Whenever this occurs the affected plants should be promptly dug up and burned, both to destroy the fungus and to avoid propagating new plants from those which are not resistant to the attacks of the parasite. The Blackberry Cane-borer is sometimes troublesome in neglected plantations, but it is readily kept in check if the old canes are cut out and burned each summer as soon as the fruiting season is over.





SMALL FRUITS: THE STRAWBERRY

The Flower and its Variations

Bring in several blossoms from different strawberry plants. Compare them with the pictures above.

Do you find that some have few or no stamens while others have many stamens?

Watch the flowers outdoors on a sunny day. Do bees and other insects visit them and fly from one to another?

Hold a reading glass over a flower which a bee is visiting. Does any pollen get on the legs and body?

Would this pollen be likely to be carried to another flower?

Varieties

What varieties of strawberries are grown in your district? Make a list under these headings:

PERFECT

IMPERFECT

Are any fall-bearing strawberries grown in your district?

Strawberry Leaf-blight

Find strawberry leaves showing the spots of this disease.

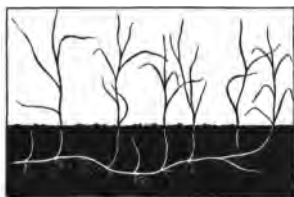
Can you find similar spots on wild strawberry leaves?

Starting a Strawberry Bed

Each pupil who can get even a small plot of land for the purpose should start a strawberry bed.

Enrich and dig up the soil thoroughly. Dig out and burn all witch-grass or quack-grass roots.

Spring is the best time to set the plants. If the main planting is of an imperfect variety, be sure to set about one-third as many of a perfect variety, placing rows of the perfect between those of the imperfect.



QUACK GRASS

THE STRAWBERRY

The Strawberry is the most popular of small fruits. It is grown in practically all home gardens worthy the name and in enormous quantities in practically all market garden regions. From the time the crops begin to ripen in the southern states in March until the last berries have matured in Nova Scotia in July the markets of the larger cities are supplied with strawberries.

The cultivated Strawberry has been developed chiefly from a plant called *Fragaria Chiloensis*. It is a native of Chili, from whence it was carried to Europe more than two centuries ago. Various attempts have been made to improve our native wild strawberry, but with small success.

Culture

Strawberries thrive best in a cool, moist, rich soil. The young plants produced from runners bear transplanting readily. In the south they are commonly set out in autumn, but in the north spring is the better season. There are many methods of culture, some growers preferring to keep each plant in a separate hill, others preferring wide matted rows, and others narrow sparse rows. The more root room and air space each plant has the better will be the fruit it produces. It is better to renew the plantation every two or three years than to attempt to keep old plantations in bearing condition.

Hundreds of varieties of Strawberries are now known. New ones are being introduced and old ones discarded every year. To a large extent successful varieties are local; they may thrive in one region and be of little value in another. So the safest way is to select for the main planting those sorts that do best in the neighborhood.

Flower Structure

In order to succeed in strawberry culture it is important to know that the flowers of many varieties possess few or no stamens while others possess an abundance of them. This condition is illustrated in the picture on page 186: on the left the stamen-bearing or perfect or staminate blossom is represented; on the right the pistil-bearing or imperfect or pistillate blossom is represented. It should be noted, however, that the so-called staminate flower possesses an abundance of pistils as well as stamens; so it is better to call it a perfect flower.

We know that the pistils of flowers must be fertilized by pollen if seeds and fruits are to develop. So it is evident that an acre of strawberries of a variety having only pistillate blossoms would be likely to yield very little fruit, although an acre of a variety having perfect flowers might set fruit in abundance. By mixing the two types of varieties, however, we can get good results because the small bees which visit the flowers so freely will carry the pollen to practically all the blossoms and thus help us in the useful work of pollenizing both kinds of flowers. So experienced growers always plant rows of staminate sorts along with pistillate varieties.

Fall-Bearing Varieties

The greatest objection to the Strawberry has been the shortness of its season. In any locality a month was about the limit of its productiveness, even if early, mid-season, and late varieties were planted. There is now a good prospect, however, that this season may be greatly extended by the introduction of a new type of plant that blossoms through the summer.

A few years ago a variety called the Pan-American Strawberry was introduced. It was claimed to bear fruit throughout the summer and early autumn. The public was sceptical at first, but those who tested the claims reported that they were true. Various seedlings of this variety were introduced later and proved to be productive through a long period. These ever-bearing strawberries established their claims so well that in the fall of 1910 the fruit growers of western New York were selling the berries in considerable quantities. The fruit found a ready market at twenty-five cents a quart.

Enemies

The Leaf-blight is the most destructive fungous disease of the strawberry. It may be found to a greater or less extent in almost any plantation, showing as distinct discolored spots upon the leaflets. It is more injurious on beds of long standing than those which are rotated frequently. In regions where there is plenty of rain in summer it is sometimes worth while to mow the leaves off after the crop is picked and then to burn the surface over when the leaves become dry. The fungus spores are thus destroyed and the new crop of leaves that soon

appears is likely to show little damage by the blight. Spraying with fungicides is also helpful.

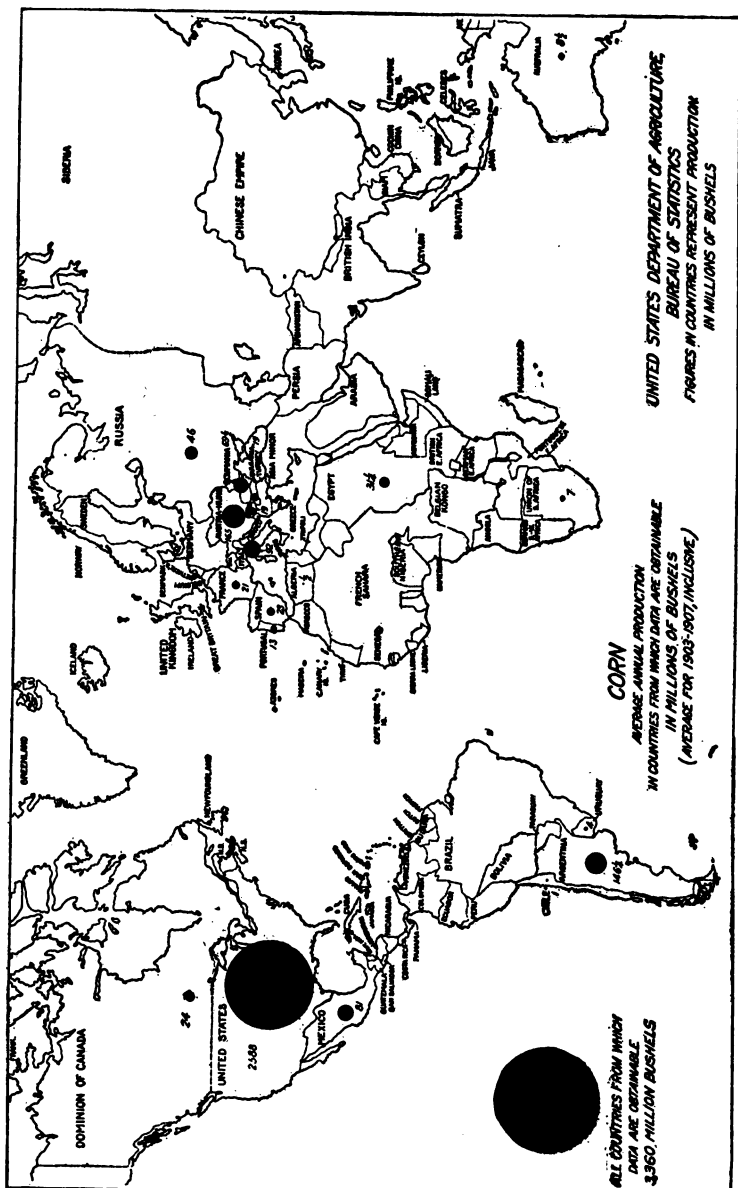
Various insects are at times destructive to Strawberry plants. The Strawberry Root-louse attacks the roots; the Strawberry Leaf-roller attacks the foliage; the Strawberry Weevil attacks the buds and stems of the staminate varieties. These and other insects are much less likely to be troublesome where the strawberry beds are fruited but a year or two and then promptly plowed under, another crop being used in rotation next season. This is really the best method to grow the fruit, so these insect enemies are helpful in promoting good horticultural practice.



IV

FARM CROPS







FARM CROPS: INDIAN CORN OR MAIZE

Corn Exhibition

Plan a corn exhibition at the school. If there is a Corn Club in the school let the Club take charge of the exhibition.

If there is no Corn Club plan for as good an exhibition as you can have. Let each pupil bring some of the best ears he can get. Arrange these by varieties.

Have different sets of pupils judge the exhibition to see which should be awarded prizes.

If possible have the yield per acre named in connection with each exhibit.

Scoring Corn

Several good ears of corn.

Let each pupil score two or three ears, using the score card on page 201.

Germination Test

Let each pupil bring in one or more ears of corn, the best that can be found.

Remove from each ear the badly shaped kernels at

the base and tip and discard them. This is the process of nubbing the ear.

Select five kernels from each ear, one from near each end and three from the intermediate spaces, each kernel coming from a different row, so that all sides of the ear will be represented.

Let each pupil fill a small paper flower pot with clean dry sand to within an inch of the top. Lay the five kernels on top of the sand, distributing them over the space. Cover them one-half inch deep with more sand. Insert a wooden or pasteboard label in each pot, printing the number of the ear, the name of the pupil, and the date on the label.

These pots are now to be watered and placed in a sunny window where they will all have the same conditions of light and heat. A shallow pan or zinc tray to hold them is desirable, but not necessary. In a few days the seeds will germinate; they should be kept growing until the little plants are two or three inches high. Then a careful examination and record should be made and all ears which show even one poor kernel out of the five should be discarded for seed purposes. The seedlings will make excellent objects for study and drawing.

Instead of paper flower pots ordinary flower pots or shallow boxes of almost any kind may be used, but the pots are simpler and easier to handle. They are not seriously injured by being used for seed testing.

Fungous Diseases

Have you ever seen an ear of corn affected by corn smut? How did it look?

Is smut more abundant on sweet corn than on field

corn in your district? Read pages 228-229 in *Farm Friends and Farm Foes*.

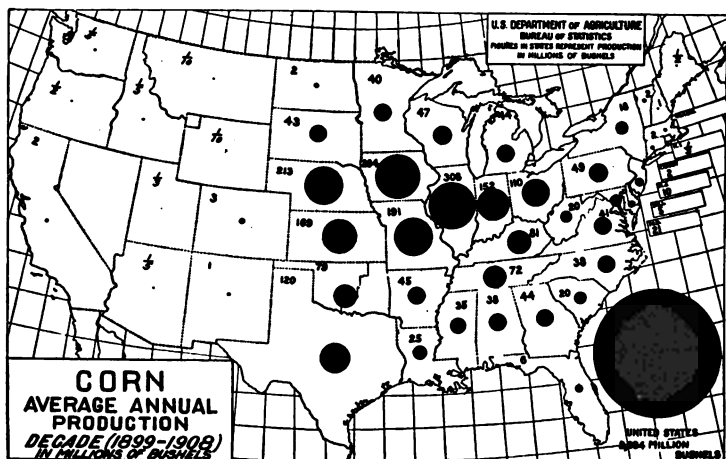
Did you ever see corn leaves with spots of orange rust upon them? This is the corn rust.

Insect Enemies

If the school is in a region where chinch bugs are found let each pupil see some of the insects through a lens. Read pages 109-111 in *Farm Friends and Farm Foes*.

In spring cutworms may often be found under boards lying on the ground along the borders of corn fields. Read pages 109-111 in *Farm Friends and Farm Foes*.

Young corn plants that seem sickly are often infested by the root aphid. Dig up such plants carefully and see if you find the aphides and the little brown ants that attend them. Read pages 92-93 in *Farm Friends and Farm Foes*. See what other insects affecting corn you can find in your district.



INDIAN CORN OR MAIZE

Corn is one of the great gifts of the American continent to the food products of the world. From prehistoric times it has been grown by the American Indians of many races in various parts of both North and South America, so that when European races first appeared Corn was found to be the staple food of the natives. Its value was at once recognized and the plant was introduced to other countries, but North America has always retained its supremacy in Corn growing. It now produces four times as much corn as all the rest of the world.

There is good evidence that the Corn plant originated in Mexico as a sport or hybrid of Teosinte, a giant grass of that region. When Columbus discovered the island of Hayti he found that Corn was grown and was called "mahiz" by the Indians. This is the origin of the word Maize, which has been commonly applied to the plant since. In Europe wheat is generally spoken of as corn, but in America the name is always applied to Indian Corn.

Classification and Structure

Corn is a giant grass with the pollen-bearing or staminate flowers in tassels at the upper end of the stalk and the seed-bearing or pistillate flowers in a spike along the side. The "silks" that project from

the latter receive the pollen from the former, thus fertilizing the ovules and causing the development of the kernels. The young plant is furnished with two sorts of roots, the regular feeding roots that grow from the sprouting kernel and the adventitious roots that grow from the stalk a little above ground and serve as brace roots in helping to keep the stalks erect as well as feeding roots.

Two important types of field corn are grown — Flint Corn and Dent Corn. Flint corn is most largely grown in northern regions, while Dent corn is the prevailing type in the Corn belt. Great improvements have been made in recent years in perfecting strains and varieties of both types, the total yield having been increased by millions of bushels through careful breeding and selection of seed.

In commercial value Corn is the most important crop grown in the United States. More than a hundred millions of acres yielding more than two billion bushels are planted yearly. The money value of the crop generally exceeds a billion dollars. More than twice as many acres of corn are planted as of wheat, and about four times as many bushels of corn are produced.

Culture

A deep, fertile, well-drained soil with an abundance of humus and in good tilth is desirable for the growth of corn. Sod land plowed the previous fall is especially good, except that it renders greater the danger of injury by white grubs, cutworms, and other grass-feeding insects. The seed is planted as soon as the soil warms up, so that it will germinate quickly and danger from

injury by frosts be over. The proverbial time for planting corn is when the oak leaves are as large as squirrels' ears. On a large scale the seed is commonly planted in check rows, three and one-half feet apart, so that the cultivator can be run in both directions, thus keeping the weeds down with little hand labor. As the plants get larger the cultivation must be shallow or the roots near the surface will be broken off. The details of culture and methods of harvesting vary with the locality and the area planted. It is highly important that Corn be planted as a part of a system of rotation in order to maintain the fertility of the soil.

Selecting and Testing Seed Corn

During recent years the importance of selecting and testing carefully the seed corn to be planted has been more and more appreciated. By such care the quality and quantity of the yield may be greatly increased and consequently the profit of growing the crop be also increased. Every vacant hill in a field of corn is a distinct loss and anything that can be done to prevent such vacancies means a clear gain.

It is now generally recognized that the only way to proceed in selecting corn is to choose the ear as the unit. It is preferable that such ears be chosen in the field when the characters of the parent plant as to earliness, height, mode of growth, and other things may be considered, but where this is not done the individual ears should be carefully selected as to their appearance. "These physical characteristics and properties," as Professor Hopkins says, "include the length, circumference and shape of the ear and of the cob; the number

CORN SCORE CARD

KENTUCKY AGRICULTURAL EXPERIMENT STATION

Name of Variety.....

Class.....

Sample Number

		1	2	3	4	5	6	7	8	9	10
Trueness to Type	Points 15										
Shape of Ears	10										
Length of Ears	10										
Circumference of Ears	5										
Tips of Ears	5										
Butts of Ears	5										
Color of Kernels and Cobs	10										
Uniformity of Kernels	10										
Shape of Kernels	10										
Spacing of Kernels	10										
Seed Condition	10										
Total	100										

Remarks:

of rows of kernels and the number of kernels in the row; the weight and color of the grain and of the cob; and the size and shape of the kernels." Many score cards have been prepared for judging corn according to these characteristics: one such card is printed on the previous page.

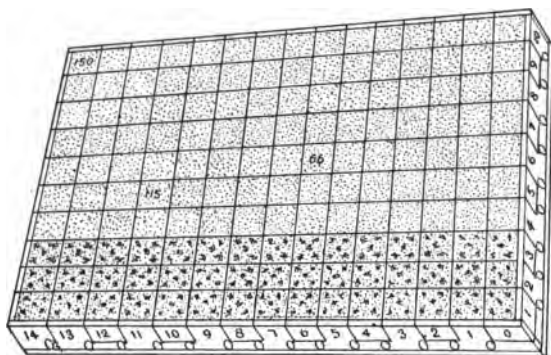
The corn planted for seed should come from such selected ears. The kernels of each ear should be tested for germination and growth before planting and all which are inferior in this respect should be discarded. A simple and interesting test may be easily made in the schoolroom, in accordance with the directions already given.

Pupils who have many ears to be tested at home may well make such a testing box as is shown in the picture on page 203. It is described by F. W. Howe in these words:

"The only materials needed are a shallow wooden tray, a small handful of carpet tacks, a few yards of wrapping twine, sand enough to fill the tray, and three or four quarts of water. The tray (or several of them) can easily be sawed from an empty soap or cracker box. When finished, it should be about $1\frac{1}{2}$ inches deep inside, 15 inches wide, and 23 inches long; but any of these dimensions may be varied slightly. This tray is divided into small squares by a checkerboard lacing of twine across the top. It is convenient to have these squares about $1\frac{1}{2}$ inches on a side, ten of them in a row across the narrow way of the tray, and fifteen the other way.

"The picture shows the general appearance of such a tray and the method of lacing the twine back and forth across the tray and under the tacks. This lacing with

the string should not be done until the tray has been loosely filled with dry sand heaped up a little above its top edge. Then the sand should be scraped off with a yardstick, or other straightedge, even with the top of the tray. After lacing with the string the tray is then ready for planting."



SAND TRAY FOR TESTING SEED CORN

Five kernels of corn from various parts of one ear are placed in each square. All are covered with sand and left to germinate and grow until about two inches high. An examination then readily shows which ears should be discarded for seed.

The Rag Doll Seed Tester

A simple way of testing individual ears is described by H. D. Hughes of the Iowa Experiment Station. He calls it the Rag Doll Method.

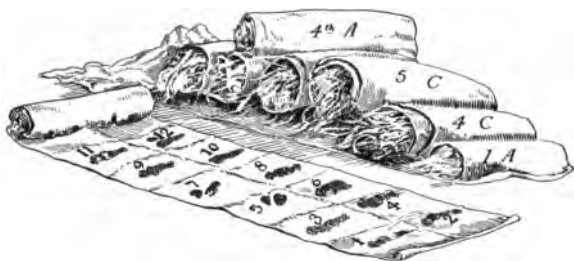
"In preparing to make this test, secure sheeting of a good quality and tear into strips from 8 to 10 inches wide and 3 to 5 feet long. Where these are to be used very

much it is well to hem the edges as otherwise the ravelings sometimes disarrange the kernels in unrolling. Each cloth should then be marked with a heavy pencil, first, lengthwise in the middle and then crosswise, as shown in the accompanying illustration, making squares about 3 inches wide. Number the squares as shown in the illustration also.

“Moisten one of these cloths and lay it out on a board of convenient size in front of the ears which are to be tested. Remove six kernels from ear No. 1 and place in the square No. 1 in the upper left-hand corner of the cloth. Take six kernels from ear No. 2 and place in square No. 2 in the upper right-hand corner, ear No. 3 in the next square on the left-hand side, and ear No. 4 in a corresponding position on the right side. When the cloth has been filled begin at the upper end with ears Nos. 1 and 2, etc., and roll the cloth up. Since the cloth is moistened the kernels will not push out of place. If a small irregular shaped piece of wood or some other substance is used as a core in rolling, a more uniform germination may be secured. When the rolling of the cloth has been finished, tie a string rather loosely about the middle of the roll; or better still, use a rubber band, and number this roll No. 1. Then proceed with roll No. 2 in the same way. As many rolls may be used as are necessary to contain the corn which one has to test. From 20 to 50 ears can be tested in each roll, depending upon the length.

“After the rolls have been filled they should be placed in a bucket of water where they may remain for from 2 to 18 hours, depending upon the preference of the operator. At the end of this time pour off the water

and turn the bucket up-side-down over the rolls — or a common dry goods box may be used for this purpose. A couple of small pieces of wood should preferably be laid under the rolls and one edge of the pail should be lifted from one-half to one inch in order to give sufficient ventilation. . . . At the end of five days the kernels should be ready to read.



RAG DOLL SEED TESTER

This may be made at home or bought of a hardware dealer for ten cents

“Depending upon the arrangement of the ears, select, first either roll No. 1 or the last roll filled. This cloth will be unrolled in front of the ears which are represented. Examine all kernels carefully. In all cases in which six kernels are not strong in germination the ear should be thrown away.”

Fungous Diseases

For a crop that has been grown in such quantities over so large an area and during so long a period, Indian corn is remarkably free from fungous diseases. Rust and Smut are practically the only widespread diseases and neither is injurious to any great degree. Corn Rust is indeed of scarcely any practical importance, while the

Smut becomes appreciably destructive only when proper crop rotation is neglected.

Corn Smut is familiar to every farmer and most gardeners; for it is especially troublesome in gardens where sweet corn is grown year after year. The disease attacks



CORN SMUT

both ears and tassels, generally the former. It first shows on the ears as a white, malformed mass, representing usually only a portion of the kernels. The mass soon becomes darker and

finally develops into a blackish powder that consists of millions of tiny spores. The disease is spread by these spores which infest young plants. The pulling and burning of diseased plants and regular crop rotations are effective preventives.

Insect Enemies

The corn plant has been much less fortunate in the case of its insect enemies than in that of its fungous foes. A host of sucking and biting insects prey upon root, stalk, leaf, and ear, often causing enormous losses.

The Corn Root-worms are among the most serious of these pests: there are two species, the Northern and the Southern. The Northern Corn Root-worm infests most of the corn belt. A small green beetle lays eggs in the corn fields in autumn. These eggs hatch in spring into slender worms that attack the roots, and mature into another generation of green beetles during the summer.

The Southern Corn Root-worm is the more destructive in the south. The adult is a small yellow beetle with black spots that feeds upon a great variety of succulent plants. Rotation of the crop is an efficient remedy for the northern species and is helpful for the southern.

Corn roots are often attacked by the Corn Root Aphis, which is always associated in an interesting way with a small brown ant that burrows channels in the soil beside the roots to make room for the aphides. The latter suck the juices of the roots, causing a dwarfing of the plants. Rotation is the best preventive.



CHINCH BUG
Magnified

Corn is a favorite food plant for the notorious Chinch Bug, one of the most destructive American insects. This pest attacks any of the grain crops and when abundant often ruins whole fields. The adult insects pass the winter in the shelter of leaves, grass roots, boards, stones, or other protection and scatter to grain fields in spring. Eggs are laid upon the grain plants, several hundred being laid by one bug, and the little bugs that soon hatch suck the sap from leaves and stalks. They molt several times before becoming full grown in early summer. They then lay eggs for a second brood more abundant than the first. Burning over the winter quarters of the pests is one of the most effective remedies.

The Cutworm is proverbial as an enemy to corn. Witness the old rhyme about planting:

One for the cutworm,
One for the crow,
One for the blackbird,
And three to grow.

There are at least a dozen kinds of Cutworms that may attack corn and their injuries are often very serious. They usually live through the winter as half-grown larvae, so they are ready to devour almost any green and succulent plant when spring comes. They travel at night from hill to hill, cutting off the stalks just above the ground, and bury themselves in the soil by day. They soon become full grown as larvae, burrow into the soil, and change to pupae, to change again a little later to night-flying moths about an inch long. These moths are attracted to grasslands to lay their eggs, and so it happens that corn on sod land is much more likely to suffer from cutworm attack than that which has been in cultivated crops.

Many other insects are at times injurious to corn. Wireworms attack the roots, Army-worms and grasshoppers attack the leaves, Corn-worms and Ear-worms attack the ears. These and other pests are more or less local, however, and like most of the other corn enemies are least injurious where good agriculture brings clean culture and regular rotations.

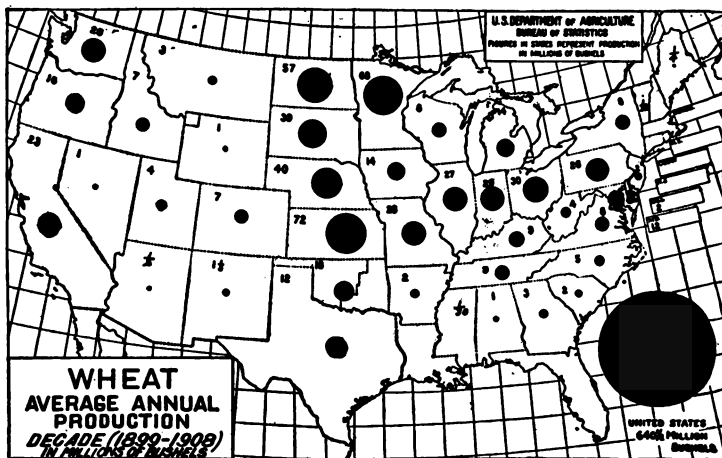


Nymph



Adult

GRASSHOPPER



GRAIN CROPS: WHEAT

Small Grain Exhibit

Have a little exhibit of small grains, especially wheat, rye, barley, and oats. Let pupils bring grains or heads so far as they can. Mount pictures from seed catalogues.

Let each pupil learn to recognize each grain so he can name kernel or head. After the exhibition has been on a few days have a recognition test applied to each pupil.

Germination Test

Ten seeds for each pupil.

Determine percentage of germination.

Draw a seed after germination.

Growing Seedlings

Grow seedlings in window box collectively or in flower pots individually till they are a few inches high.

Draw when they are an inch high; also when three inches high.

Crop Rotation

Learn what crop rotations are practiced by local wheat growers.

Which rotations seem to bring the largest yields per acre?

Fungous Diseases

Which wheat rusts can you find in your locality? If both are present which is more destructive? Read pages 235-237, *Farm Friends and Farm Foes*.

Are some varieties of wheat more subject to rust than others in your region? What varieties are most nearly rust proof?

Can you find both kinds of Wheat Smut in your locality? Which is more destructive?

Do any farmers in your region treat their seed to prevent Smut? If so what is the result?

If the loss from wheat diseases in your township is ten per cent of the crop, what is the money loss?

Hessian Fly

Inquire of farmers who grow wheat whether the crop has been injured by Hessian flies in recent years.

If any field is now infested bring specimens of injured stalks to school so that each pupil can see the insects.

If examples of the flax-seed stage are found, keep alive in a covered jelly glass or similar receptacle to rear the adult flies.

Learn what preventive measures are in use against the Hessian fly. Read pages 123-124, *Farm Friends and Farm Foes*.

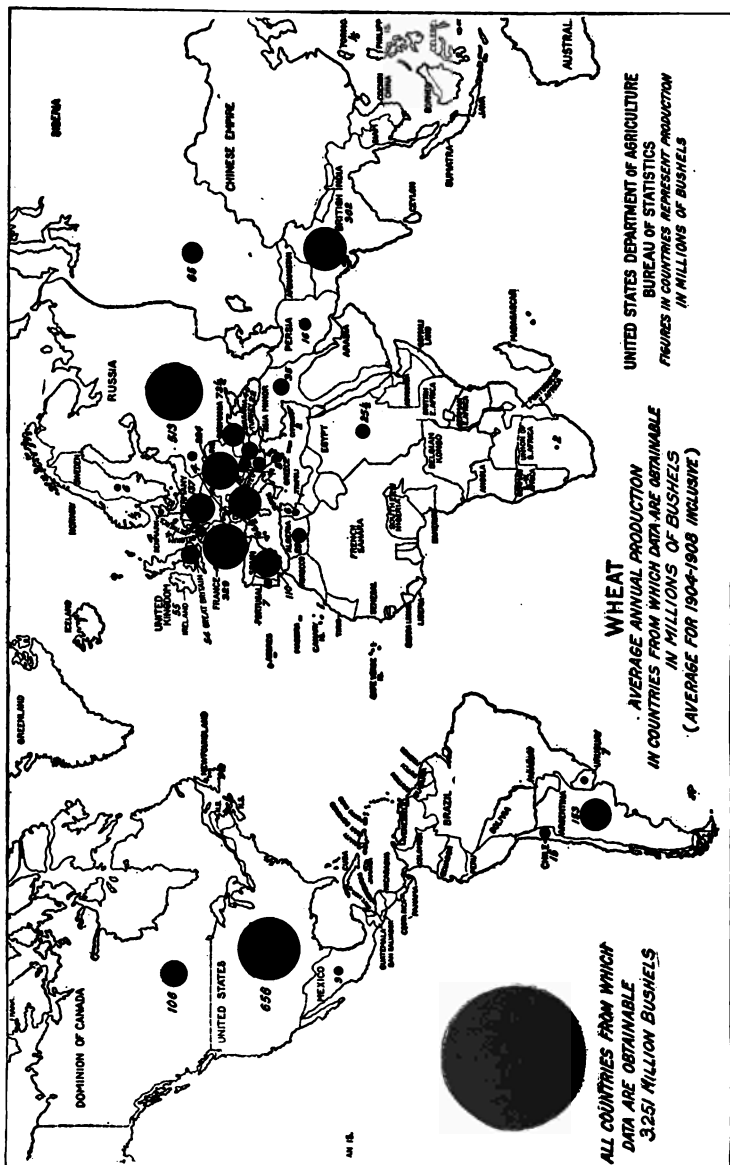
Other Insects

What other insect enemies of wheat occur in your district?

Do cutworms, grasshoppers, or leaf-hoppers cause much injury?

Look in the wheat fields for the wheat bulb worm, the joint worm, or the wheat midge.





WHEAT

From time immemorial Wheat has been grown for human food. It has always been the staple food of the most highly civilized peoples and it seems likely to continue to hold its high place for ages to come. Bread, the finished product of the Wheat kernels, is universally recognized as the staff of life.

In all their wanderings over the habitable globe the European races have carried the Wheat plant with them. Wherever they have stayed the seed has been sown, and if the conditions permitted the grain has been harvested. Consequently the plant has been subjected to innumerable changes of soil, climate, and culture, and it has responded to those conditions in such a way that many well-marked types of varieties have been developed and are now grown in America. They are grouped first into Winter Wheats, sown in autumn and living over winter as young plants, and Spring Wheats, sown in spring and harvested the succeeding summer.

These in turn are subdivided thus:

Winter wheats: Soft, semi-hard, hard

Spring wheats: Soft, hard, Durum or Macaroni

In general each of these types is suited to certain great regions where it is chiefly grown. The hard wheats are especially prized for making flour, while the very hard Durum or Macaroni wheats are utilized for making macaroni.

Culture

Wheat is universally grown as a field crop with the seed drilled or broadcasted over the soil. The details of time of planting, kind of soil, fertilizers and place in the rotation differ with the locality and the type, but in general Wheat is a crop for extensive rather than intensive farming methods. The processes of preparing the land, seeding and harvesting and threshing are done to best advantage on a large scale by expensive machinery. So the crop is especially adapted to the immense fields of the fertile west and northwest, where the so-called bonanza farms are the prevailing type. This does not mean, however, that Wheat cannot be profitably grown on a smaller scale in other regions, for it is recognized as one of the most profitable crops for the general farmer over a large part of the United States.

To be grown successfully over a considerable period of years Wheat must be fitted into a rotation with other crops, preferably with a series in which clover, cowpeas, or some other nitrogen-gathering legume is included. In the great diversity of regions in which Wheat is grown in America there are many different rotations of crops that include it. Some of the most important are these:

Potatoes, Wheat, Clover

Corn, Wheat, Clover

Corn, Cowpeas, Wheat, Clover

Corn, Oats, Wheat, Clover

Potatoes, Oats, Wheat, Clover

Sugar-beets, Wheat, Alfalfa (continuing several seasons).

Improving Varieties

A great deal of attention has been given during recent years to improving Wheat by breeding and selection. Many new varieties of great value have been obtained as well as greatly improved strains of the older varieties. In some extremely valuable work conducted by the Minnesota Experiment Station under the direction of Professor W. M. Hays an increased yield of from two to nearly five bushels of grain per acre was obtained in a very few years. Large heavy kernels are best for seeding, and an interesting machine has lately been devised for separating these from the lighter kernels. The grain is shot from a revolving cylinder in such a way that the centrifugal force sends the heaviest grains farther than the others.

Fungous Diseases

It is not surprising that so important a crop as wheat, grown from time immemorial in so many parts of the world, should have numerous natural enemies. Parasitic fungi of several kinds and insects in great variety have found in various parts of the wheat plants favorable opportunities for food and growth. The yearly loss due to these enemies amounts to many millions of dollars, a large proportion of which might be saved by the intelligent application of the best agricultural methods.

Two distinct species of rust fungi attack wheat — the Black Stem Rust and the Orange Leaf Rust. The first is the most destructive, causing a shriveling of the wheat kernels that results in greatly reduced yields. The second is more universal in its distribution, being found in practically every wheat field every year, but it does less damage because it affects kernels less seriously. The

most promising methods of preventing both these diseases is that of planting rust-resisting varieties, many of which are now known.

Two distinct species of Smut fungi attack wheat heads — the Bunt or Foul-smelling Smut and the Loose Smut. The Bunt infests only the wheat kernels, so that it does not show as conspicuously in the heads as the Loose Smut, which infests both kernels and chaff. Both of these diseases are common in North America and often cause the loss of millions of dollars a year.



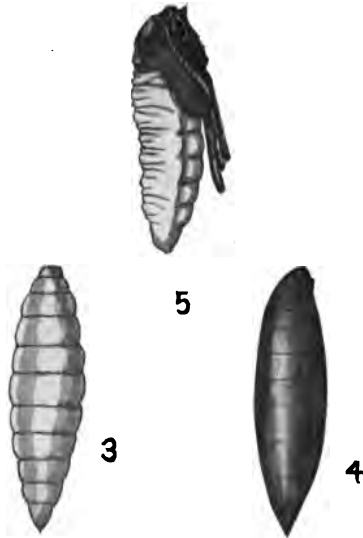
HESSIAN FLY

1. Infested plant 2. Eggs on leaf

Hessian Fly

The Hessian Fly is the most destructive special insect enemy of the wheat crop, though at times greater damage may be done by the Chinch Bugs and Army-Worms which attack other grains in addition to wheat. Good authorities estimate that the average annual loss of wheat due to the Hessian Fly is ten per cent, or about 40,000,000 bushels. Of course the damage at times is much greater than this in certain regions where the crop may be reduced one-half or more, if not completely ruined. It occurs practically throughout the principal wheat regions of the United States. It is called the Hessian Fly because it is supposed that it was first brought to America by the Hessian soldiers during the Revolution.

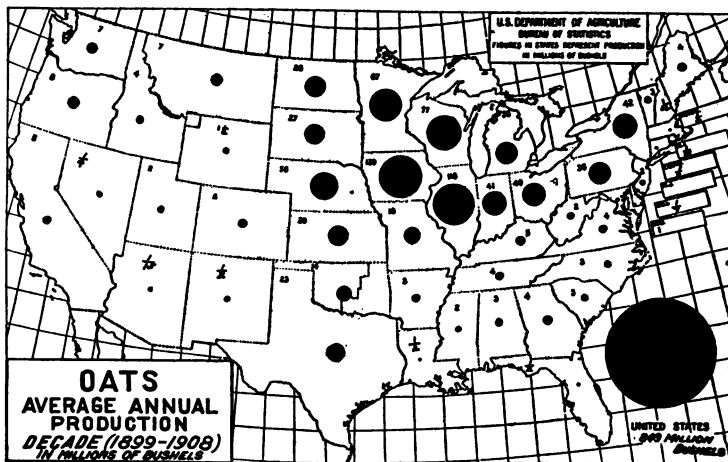
In winter wheat regions damage by the Hessian Fly may often be prevented by late seeding, although the time when this is effective varies with the locality and the season. Many of the insects in the flax-seed stage pass the summer in wheat stubble. These may be destroyed by burning over the stubble fields or plowing deeply and rolling. An adequate system of crop rotation is very helpful in preventing outbreaks, while the selection of varieties having strong stems or the habit of tillering freely is helpful in preventing damage when the pest is present. The adult Hessian Fly is shown much magnified in the picture below.



HESSIAN FLY

3. Larva. 4. Pupa. 5. Pupa. Magnified.





GRAIN CROPS: OATS

Types of Heads

Let pupils bring to school good heads of oats grown at home. Get the name of the variety when possible.

Arrange these oats heads into two groups:

SPREADING OR OPEN PANICLE

BANNER OR SIDE PANICLE

Seed Testing

Twenty seeds for each pupil.

Place in germination box and determine percentage of viable seeds.

Varieties

Learn what varieties of oats are grown in your district.

Let pupils find out facts to put on the blackboard under these headings:

Yields of Oats per Acre

HIGHEST	LOWEST	AVERAGE
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

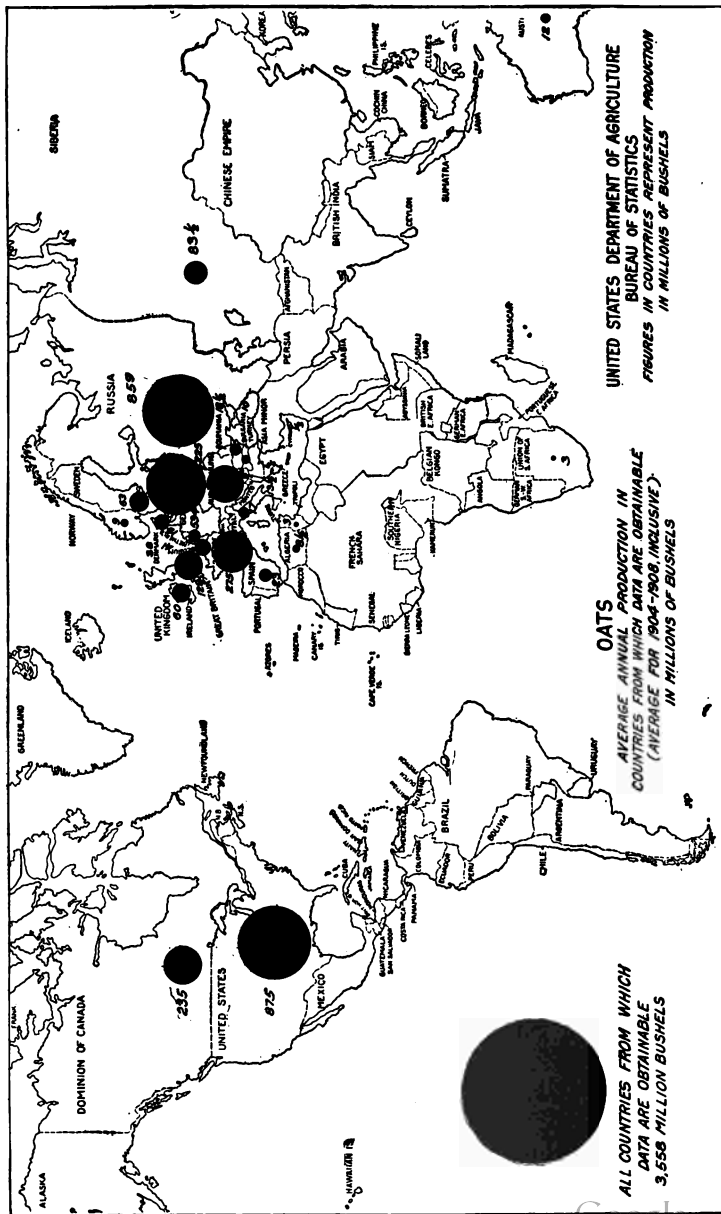
Enemies

Learn which of these diseases occur in the school district: loose smut, stem rust.

Do local farmers treat the oats to prevent smut?

Are oats plants troubled by any insect enemies?





OATS

Oats rank with wheat and corn in the number of bushels grown in the world. Thus in 1904 there were produced on all the continents

Oats, 3,336,179,000 bushels

Corn, 3,058,021,000 bushels

Wheat, 3,162,340,000 bushels

In the case of Oats about one-third of the total yield was grown in America and nearly two-thirds in Europe, the total yield of Asia, Africa, and Australia being less than 100,000,000 bushels. On the other hand more than a billion bushels were grown in Russia alone, nearly as much as in all the rest of Europe.

During the decade before 1909 the average annual production of Oats in the United States was nearly 900,000,000 bushels. Illinois, Iowa, Wisconsin, and Minnesota were the four leading states in Oat production, these and Nebraska producing more than half the total crop. The diagram on page 218 shows the production of each state during the period named.

Classification

The numerous varieties of Oats are classified in various ways. One of the most convenient of these has to do with the position of the spikelets on the panicle. In one group the spikelets spread from the central stalk in all directions: these are the Spreading or the Open-panicle

Oats; in the other group the spikelets are on one side: these are the Mane or Banner or Side-panicle Oats. The first group contains the most popular varieties.

Culture

Oats are cool-season plants. They thrive best in cool weather and a moist soil. Consequently they are most successful in northern regions, where they form one of the most important elements in farm rotations. They should be planted early in well-prepared soil, the seed being covered an inch deep. The plants come up quickly and grow rapidly, maturing early in summer. A fair yield in the northern states is fifty bushels an acre, although the average is much below this.

A distinct advance in the growing of oats in the southern states has been brought about by the introduction of the "open furrow" method of seeding. The seed is sown in the fall on land which has been plowed and harrowed, being drilled in the bottom of furrows four inches deep made by a special machine. The young plants get well started before winter and the furrow is gradually filled in by the alternate freezing and thawing of the soil. The percentage of winter killing is thus greatly reduced and the roots are so far down that they are better able to withstand the droughts of spring or early summer.

Enemies

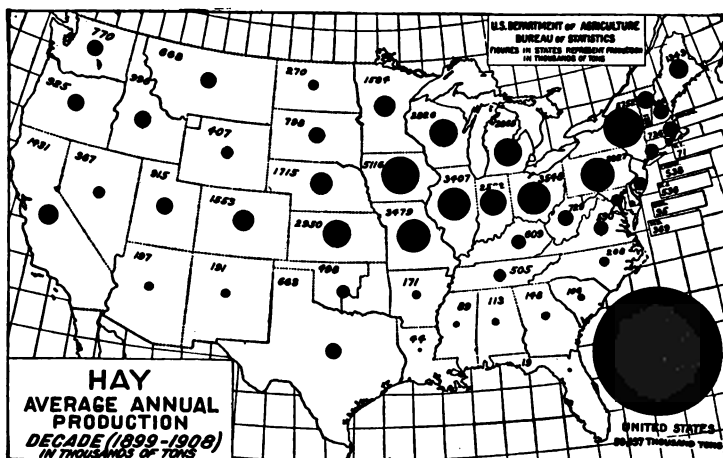
The Loose Smut is the most destructive fungous disease of oats. Its life-history is similar to that of the Loose Smut of Wheat, the spores being attached to the seed and entering the seedling soon after germination.

The formalin treatment is an efficient remedy, and on a given farm will prevent serious loss if the seed oats are treated every second or third season. The necessity of this treatment is indicated by the statement that the annual loss in the United States due to the disease has been estimated at nearly \$20,000,000.

Not infrequently the Stem Rust of Oats does a great deal more damage in a given region than the Smut. This is similar to the Stem Rust of Wheat, having both a black and a red stage and is most destructive in wet seasons. The selection of resistant or early maturing varieties is the only method of prevention. In the southern states the kind called Texas Rust-proof is the most resistant, while in the north the White Russian has a similar reputation.



The growing crop of oats is subject to attack by Chinch bugs, army worms, and various other grain and grass-feeding insects, but there are few special insects affecting oats.



FORAGE CROPS: GRASSES

Exhibit of Grasses (Summer or Autumn)

Plan a little exhibit of the common forage grasses.
It should be easy to get most of these:

Timothy	Witch Grass
Kentucky Blue-grass	Orchard Grass
Red Top	Barn yard Grass

Place in bottles of water if the specimens are freshly cut, or mount on stiff paper if they are dry.

Find out which kinds are most largely grown for hay in the district.

Have a recognition test after the plants have been on exhibition for a few days.

GRASSES

The food for domestic animals derived from pasture and hay crops is one of the most important items in the total of American crops. The average annual production of hay alone is about sixty million tons, while the food derived from pastures is almost beyond calculation. The various grasses are the most important hay crops, although they are often combined with various clovers and in some regions are largely replaced by alfalfa. Timothy or Herd's Grass, Kentucky Blue-grass, and Red Top are most notable as hay and pasture grasses.

TIMOTHY OR HERD'S GRASS

Timothy or Herd's Grass (*Phleum pratense*) is universally recognized as the great hay grass for American farms. It is easily established and easily destroyed when land is plowed for another crop. It yields heavily. The hay is of high food value and is relished by both horses and cattle. Seed sown this year will produce a good crop during the next two years and also in subsequent years if the meadow receives proper top dressings. Red clover is commonly mixed with Timothy in planting.

Interesting and remarkable results have lately been secured in the breeding of Timothy plants at Cornell University. Variations as to the habits of growth, earliness, yield of leaf and seed, and other characterizations have been found, and definite progress has been

made in establishing numerous varieties for special purposes.

BLUE-GRASS AND RED TOP

While Timothy as now grown is preëminently a hay plant and only secondarily a pasture grass the reverse is true of Kentucky Blue-grass (*Poa pratensis*), famous the world over as the best basis for a productive pasture. It is early and succulent and continues growth well through the season, though likely to be checked during the hot dry months of summer. It is especially valuable for pastures because of the way it spreads out from a single plant, being strongly stoloniferous. In consequence it takes possession of the soil and crowds out weaker plants.

As a meadow grass Red Top (*Agrostis alba*) ranks next to Timothy and on wet or sour soils it is to be preferred to it. It gives a good crop of hay the season after sowing and will thrive under conditions in which Timothy fails. It is strongly stoloniferous and may be used to advantage in seeding down the pasturage.

OTHER GRASSES

Orchard Grass, Meadow Fescue, Canada Blue-grass, and Barn-yard Grass or Japanese Millet are also grown more or less in the northern states. In the southern states Bermuda Grass is of especial value for pastures and Johnson Grass for hay. The latter has the same rooting habits as Witch Grass and so is very difficult to eradicate when once established. Consequently it cannot be used to advantage in a system of crop rotation.

Meadows and pastures of long standing become sod

bound, so that the grass does not thrive and other stronger plants begin to come in. Daisies, wild carrots, plantains, flea-banes, hawkweeds, and many other weeds commonly infest such grass fields. Their presence is an indication of the need of a renewal through plowing and rotation — the most effective method of dealing with weeds in grasslands.





LEGUMINOUS CROPS: THE CLOVERS

Exhibit of Legumes (Summer or Autumn)

Plan a little exhibit of as many kinds of clovers and related plants as can be found growing in the neighborhood. Most localities should show these:

Alsike Clover

Alfalfa

Red Clover

Sweet Clover

White Clover

Pussy Clover

Place two or three blossom-bearing stems in a bottle of water. Put a plainly printed label by each. After two or three days remove the labels and have a recognition test.

In case of doubt about the name of any plant brought in let the pupil send it to the State Experiment Station for identification.

RED CLOVER

Seed Inspection

Examine through a lens one hundred seeds of red clover from the stocks offered for sale locally.

See how many are really clover seeds and how many are seeds of other plants.

Seed Germination

Determine the per cent of viability of twenty-five seeds placed in germination without preliminary treatment, allowing seven days for germination.

Treat twenty-five other seeds from the same lot with sulphuric acid for twenty minutes. Determine the percentage of viability and compare quickness of germination with that of the untreated seeds.

Root Nodules

Dig up a thrifty clover plant carefully. Wash the soil from the roots. See the little yellowish nodules on them.

Make a drawing of a root showing some of the nodules.
Read pages 275-281, *Farm Friends and Farm Foes*.

Clover Soils

Bring to school a half pint of soil in which clover thrives.

Bring also a half pint of soil from a field in which clover does not grow — one in a low situation or an old pasture or meadow.

Test each with blue and red litmus paper, simply covering the paper with the damp soil.

If the soil is sour the blue litmus paper will turn red.
Clover does not thrive in sour soils.

Now mix a little powdered lime with the sour soil, stirring it up thoroughly and then letting it stand for a day or two. Then test again. What effect does lime have upon a sour soil?

THE CLOVERS

Until recently Red Clover was the most important leguminous crop known to American agriculture. It is still so in the eastern United States, but in western regions it has been eclipsed by Alfalfa, which seems likely also to largely supplant the clover in the east. Two important forms of Red Clover are grown: the Common or June Red Clover (*Trifolium pratense*) and the Mammoth Red Clover (variety *perenne*). The former is smaller, ripens earlier, and dies sooner than the latter, which by contrast is larger, ripens later, and lives longer.

Two other important clovers are the Crimson and the Alsike Clover. The former is largely used as a cover crop in orchards and the latter as a forage crop for meadows and temporary pastures. Neither of them, however, is so largely grown as Alfalfa or the Red Clovers.

Clovers in Rotations

The Clovers, especially the Red varieties, have long been recognized as an essential crop for any good system of crop rotation. Long before the way in which the legumes are able to collect nitrogen from the air and add it to the soil was understood, it was known that they did increase the supply of nitrogen. So they were largely grown to plow under as green manures and they still hold a very important place in this respect.

Clover will not thrive upon an acid soil. The nodule-

forming bacteria upon which their growth largely depends are unable to develop in such a soil. Consequently it is often necessary to add lime in order to get Clover to grow, and very often it is desirable to inoculate the soil with the nodule-forming bacteria.

Enemies

Where Clover is utilized as a part of a plan of crop rotation that involves plowing it under after one season's crop has been removed it is comparatively little injured by insect pests. When it is grown longer, however, such enemies are more likely to multiply and prove destructive. Two of these pests attack the roots: the Clover-root Borer and the Clover-root Curculio. As adults both are small beetles that lay eggs on leaves or crowns of clover in spring, the eggs soon hatching into small larvae that feed upon the roots. When either proves troublesome the adoption of a system of short crop rotation is desirable.

The Clover-leaf Beetle is another insect which has sometimes been troublesome in clover fields. The brownish snout beetle, about half an inch long, feeds upon the leaves and deposits eggs upon the stems. The larvae that hatch from the eggs feed upon the leaves for



RED CLOVER: EFFECT OF BACTERIA

several weeks. Then they pupate at or just beneath the soil surface, to emerge a little later as beetles. Plowing the crop under in May or June is an effective remedy, as it destroys the larvae.

If you take a dozen clover blossom heads, especially such as show a green and dwarfed condition, and shake them violently over a sheet of paper you may often dislodge tiny orange colored maggots, about one tenth of an inch long. These are the larvae of the Clover-seed Midge, an insect that often greatly reduces the crop of clover seed. The adult is a small two-winged gnat, with a long ovipositor by means of which it inserts eggs into the young florets of the red clover head. From these eggs the orange colored larvae hatch and develop at the expense of the embryo seeds. When full grown the larvae wriggle their way out of the head and fall to the ground, where they form slight silken cocoons within which they change to pupae. About ten days later they change again to the gnat-like flies that lay eggs for another brood of larvae.

The injuries of the Clover-seed Midge are especially serious only in case the crop is grown for seed. Infested fields are distinguished by the green and dwarfed condition of the heads at blossoming time. The best preventive seems to be that of mowing the field in spring when the green heads are forming. There is thus produced a crop of blossoms which escape attack.



LEGUMINOUS CROPS: ALFALFA OR LUCERNE CLOVER

Seed Inspection

Examine with a lens samples of Alfalfa seed offered for sale locally.

Determine the percentage of impurities as represented by seeds of other plants.

Sort these out and determine as many as possible by comparison with the collection of named seeds.

Determine the percentage of dodder seed present.

Seed Germination

Determine viability without preliminary treatment, using twenty seeds and allowing ten days for germination.

Treat ten minutes with concentrated sulphuric acid. Wash through tea strainer to free seeds from acid.

Now determine viability and compare the results with the results from untreated seeds.

Root Nodules

Dig up carefully some alfalfa plants. Wash roots in water. Spread out to dry.

See the little nodules on the roots that enable the plant to take nitrogen from the air. They look like the picture below which shows similar nodules on the roots of Soy beans.

Draw some of the nodules.

Enemies

Examine alfalfa leaves for leaf-spot and other fungous diseases.

See if you can find specimens injured by dodder.

Look for insect enemies in alfalfa fields.



ALFALFA

Alfalfa or Lucerne is a member of the great Legume Family and is called by botanists *Medicago sativa*. It is one of the oldest forage crops, having been known in Persia and Greece centuries before the beginning of the Christian era. It was introduced to the American continent by the Spanish invaders during the sixteenth century and was brought to Texas and California from Mexico and South America during the nineteenth century. It proved so well adapted to the western soils that it rapidly became a staple crop and is now the most important forage plant in the great region west of the Mississippi river.

The extraordinary value of Alfalfa is to be explained in part by the great length of the roots and their ability, with the aid of nodule-forming bacteria, to gather free nitrogen from the air. Their deep descent and large extent enable them to get moisture even when the soil surface is dry and their ability to use free nitrogen gives them nutriment for vigorous growth year after year without the renewal of the field. These two factors probably account for the remarkable ability of the plants to send up new shoots when those already grown are cut off, so that six or more crops may be harvested in a single season. Another important element is found in the extraordinary richness of the leaves and stems in protein, this fact giving them great value in feeding stock of almost any kind.

The long tap-root and other characteristics of the Alfalfa plant especially adapt it to the deep soils and the long seasons of the southern and western states. In Arizona the crop can be cut over eight times in a single season. But the plant also has decided value in the northern and eastern states. As its requirements are being better understood it is becoming a standard crop even in New England. Although it probably cannot take the place in eastern agriculture that it does in western regions, it can become of greatest importance here.

Culture

Alfalfa is more difficult to get well started than many other crops. It requires a rich, non-acid, weed-free soil, in good tilth, in which the nodule-forming bacteria are present. Many eastern soils must be treated with lime to counteract their acid condition and nearly all must be inoculated with Alfalfa or sweet clover bacteria. To do this a few bushels of soil from ground in which either of these plants have been growing thriftily are scattered over each acre to be seeded and quickly harrowed in. Late summer or early autumn is the best time for seeding.

Much of the value of Alfalfa lies in the leaves. It is important that the crop be cut early enough to save these from dropping off. As soon as ten per cent of the heads are in blossom it is time to cut the crop. The new crop of stems and leaves start sooner and better after such early cutting.

Enemies

It is not strange that a crop grown over large areas for many years in the same soil should have developed

many enemies. When once introduced into such a field the conditions for the development of the parasite are very favorable. So we find that Alfalfa is subject to more than a dozen fungous diseases, some of which at times become very destructive.

The Alfalfa Leaf Spot is the most widespread of these fungous diseases, as it is present in nearly every alfalfa field and often causes the dropping of a large part of the leaves. The small brownish black spots are thickly scattered over the leaflets, which soon become yellow and fall away. Early cutting helps to check the trouble.

Alfalfa is especially likely to be injured by the parasitic plant called Dodder. This is not a fungous but a true flowering plant that grows upon the stems of other plants and sucks out nutriment from them. It grows from seed and is introduced to the field because Dodder seed is mixed with the Alfalfa seed. Consequently seed for planting should be carefully examined, and if the Dodder seeds are present it should not be planted.



V.
SOILS
THEIR ORIGIN, CHARACTERISTICS
AND IMPROVEMENT

THE MAKING OF THE SOIL

OBSERVATIONS ON SOILS

If you live in a region where there are rocky ledges, examine different parts of the ledges to see if you can find where particles of rock have been broken up to help form soil. Notice the plant growths upon the ledges and see if there are fragments of such plants mixed with the rock particles. Find places between the ledges where higher plants are growing in small amounts of such soil.

Examine the soil that you find in the woods. Notice the layer of recently fallen leaves at the surface and note that the soil below is composed of leaves that have decayed. Dig down through the surface to the sub-soil and notice the differences between the layers.

Visit a swamp or a peat bog and dig into the soil in a similar way.

Visit a brook and examine the deposits of soil along its margin. Notice where sand has been carried in and deposited in pockets and where various bits of plant life, such as dead twigs and pieces of tree trunk, have been piled up to rot and form soil.

THE MAKING OF THE SOIL

The production of crops depends upon the relation between the soil and the various crop plants. The soil is made up primarily of particles of rock that have

been gradually worn away from the solid mass that originally formed the surface of the earth, together with the remains of plant and animal life that have been accumulating for millions of years.

It seems hard to believe that soils have thus come from rocks and ledges, especially if one lives in a prairie region where rocks are few and far between, and where the soil is deep, mellow, and rich. But if one lives near or can visit a rocky, mountainous region, it is comparatively easy to see many stages in the process of soil formation. What at first sight seems to be a bare cliff shows upon closer examination various greenish patches on the surface. These are low forms of plant life that get their materials for growth chiefly from the air and the water. At the bottom of the cliff one is likely to find a mass of rock fragments of many sizes that have dropped from the face of the cliff; these pieces of rock are often more or less mixed with little fragments of plant growth that have fallen from above. We thus have the beginning of soil formation through the mixture of rock particles and fragments of plant life. In this material higher plants soon grow, and when they die their remains are added to enrich and enlarge the mass of soil.

In a general way this is the process of soil formation which is taking place throughout the world. The soil originally formed in one place may have been carried by streams of water, by constant winds, or by the action of the great ice glaciers of a previous age from one locality to another. So even the deep soil of a rich prairie region may have come from far away during the long ages in which the world was getting ready for man to occupy it.

Fertile soils contain a considerable proportion of the partially decayed remains of plant life. This material is commonly called *humus*. In general, humus is a convenient word to use when we wish to speak of the organic material in a soil as distinguished from the inorganic material. The organic material is that which has come from living things, — plants or animals, — though we should remember that all animal materials are derived from plants. The inorganic material is the part of the soil that is derived from rocks.

If you visit a swamp, especially a peat bog, you are likely to find a soil composed very largely of humus. It is made up chiefly of the partially decayed remains of plants that have lived and died in the swamp.

From the point of view of successful crop production, the presence of humus in the soil is of greatest importance. This dead vegetation helps more than any other one thing to render the soil fit for the root growth of crop plants. It furnishes the best material for improving the physical condition of both clay and sandy soils. It helps to fill the pores between the soil particles and serves as an absorbent to hold water, thus storing it up for the use of plants. It forms a breeding place for the millions of bacteria of many kinds, which help so largely in rendering the soil fertile for plant growth. It furnishes many tiny particles for the support of root hairs and readily gives up to these the supply of food and moisture which they require.

While it is true that soils originally were made up of particles of rock mixed with the remains of plants or animals, soils as they now exist are much more complex than is usually supposed. Every fertile soil is filled

with living germs of many kinds which are continually reacting upon the soil particles and getting plant food into condition for use by crops. The lives of these lowly organisms and the effects which they produce upon the soil are so complicated that they are not thoroughly understood even by the wisest men. We know enough, however, to recognize the fact that this germ life in the soil plays a very important part in the fertility of our fields and that it is highly desirable to furnish conditions which are favorable for the development of various kinds of bacteria. Among these conditions we should include an abundant supply of air to be secured through thorough drainage and frequent tillage and a proper amount of humus well incorporated between the soil particles. Where too much humus is present, however, the soil becomes sour — a condition which is unfavorable to the development of bacteria. In such cases the addition of lime tends to sweeten the soil and make it more favorable for germ life.

These tiny bacteria live not only in the soil itself, but a very important kind lives in little nodules upon the roots of certain plants. Nearly all of these plants belong to the great family of legumes, which includes the clovers, beans, peas, vetches, and alfalfa.

THE WATER IN THE SOIL

DRAINS AND DRAINAGE

If there is an open ditch in your locality, notice it carefully, especially after a rain. Does the water run into it through the vertical sides, and does it have the effect of causing the neighboring soil to dry out more quickly than if the ditch were not there?

If you can find the place where a tile ditch opens into a brook, notice the water pouring out of the tile. Where did it come from? What is the effect upon the field of thus placing tiles in the bottom of the ditch and covering them over?

Find out, if you can, what fields in your locality have been drained by means of tile drains. Notice whether such fields are in better condition than similar fields without such drainage.

FREE WATER IN THE SOIL

Just after a rain the soil in your garden is likely to be very wet. If you dig down two or three feet the hole will probably fill with water. If you dig a ditch so that this water can run away, you will soon cause the surplus moisture in the soil to disappear, so that if you should dig another hole no water would come into it.

The water that has thus accumulated in the bottom of the hole or has run away through the drain is called the

free water of the soil. Such free water fills the pores between the soil particles, and unless there is natural or artificial drainage, it is likely to remain and keep the ground so wet that the soil becomes stagnant and then the roots of most plants cannot grow. Consequently, in productive soils there must be either natural or artificial drainage to permit this free water to run away.

The great majority of sandy and loamy soils are so situated that there is natural drainage by means of which the free soil water seeks lower levels without help from man. But in many clay soils, and in other soils which are underlaid by hard pan, it is necessary to provide artificial drainage to lower the level of this free water in the soil. The simplest way to provide drainage is to dig through the middle of a field a ditch deep enough so that the water will readily be carried away. This ditch may be left open, but in this case it takes up much room and is inconvenient. A better plan is to lay drain tiles along the bottom of the ditch and then fill in the ditch with earth over the tile. This is called tile drainage, and it is the best method of improving wet soil.

Such soils are improved by tile drainage because the surplus water runs away quickly, leaving the pores between the soil particles open to air and root growth. Consequently, the field can be worked earlier in spring, so that the crops get an earlier start and the roots go deeper.

CAPILLARY MOISTURE

If you take a handful of soil from a drained field and squeeze it tightly, you are likely to find that it is quite moist. Obviously the free water in the soil in this case

has run away, but moisture is still present. You can demonstrate this even more satisfactorily by heating a little of the soil and seeing the steam escape.

The water that is thus present in soils from which the free water has run away is called capillary moisture. Around each tiny particle of the soil is a very thin film of water that is held there by capillary attraction. If you place the lower end of a vertical string or a lamp wick in water, you will find that this string or wick soon becomes wet for some distance above the surface. The water is drawn upward along the thread by capillary attraction. This is the same force that serves to keep the film of moisture around the soil particles.

Capillary attraction also helps to keep soils moist by causing the water from below to rise constantly toward the top, very much as the oil in a kerosene lamp rises constantly to the flame. The particles at the surface lose a great deal of moisture through evaporation, especially when the ground is baked. This loss is replaced by the water that rises from below in very much the same way that the oil burned in a lamp flame is replaced by the oil contained in the lamp.

The amount of capillary moisture held by a soil depends very largely upon the fineness of the particles. The smaller and more numerous these particles are, the larger is the surface to be covered by the film of water. You can easily understand this if you make the following experiment:

Cut from a potato a cube an inch square. Estimate the amount of surface it presents. Then cut this cube into eight smaller cubes, all of equal size. Estimate the surface area which the original cube now has. By cut-

ting each of these into eight more you will easily see that the surface area depends entirely upon the size of the particles.

The water held by capillary attraction depends upon the surface area of the particles. Consequently a coarse gravel would hold less moisture than a coarse sand, and the coarse sand would hold less than a fine sand.

SOIL FERTILITY

RICH SOILS AND POOR SOILS

Notice carefully different fields in your vicinity to see which naturally produce good crops and which produce poor ones. Get samples of the soil from the different fields and examine them as to their fineness and the comparative amounts of clay, sand, and humus. Stir each soil in a tumbler of water and then let it settle. After it has settled notice the different layers.

COMMERCIAL FERTILIZERS

In the school or home garden, plant quick-growing crops like radishes or lettuce, using a small amount of commercial fertilizer for part of each row and omitting it for the rest. Watch the crops as they develop and see which starts the sooner and grows the more vigorously.

Learn which farmers in the vicinity use commercial fertilizers and for what crops. Find out whether such use is repaid by the increased yields of the crop.

ROOT NODULES

Carefully dig up the roots of clovers, peas, beans, alfalfa, vetch, or other members of the great family of legumes, and wash the soil out in water. Then examine the roots to see whether there are small nodules or tubercles upon them. These nodules contain millions of

tiny bacteria that help the plant to grow by gathering the free nitrogen from the air.

Find out what farmers in your vicinity plow under green crops to enrich the soil. Learn whether these crops belong to the great family of legumes.

SOIL FERTILITY

There are certain chemical compounds which are especially necessary for the growth of crops. The most important of these are phosphoric acid, potash, and nitrogen. Nearly all crop plants take up large quantities of these three materials, and it is often necessary to replace this loss by the addition of special combinations of chemicals containing them. Such combinations are added for the purpose of fertilizing the soil, and as these fertilizers are usually sold in large quantities commercially, they are commonly called commercial fertilizers. Most soils contain certain amounts of these substances which were originally present in the formation of the soil or have been developed through the action of bacteria or chemical compounds on the humus or other soil material.

In order to be available for the growth of crops, all of the materials that enter into the plant must be either in a liquid form or dissolved in water. A soil may contain considerable amounts of potash, phosphorus, or other elements which are locked up so far as plants are concerned, because they are not in the soluble form. One cannot always tell from the mere fact that a soil on chemical analysis shows large amounts of these essential elements that it is necessarily in a fertile condition.

Obviously the materials applied to the land in the form of commercial fertilizers should be easily soluble. As a rule the ingredients of these fertilizers are of this sort, and one can easily tell from the guaranteed analysis given by the manufacturers to what extent this is true.

Among the various chemical elements which are needed for the growth of plants, nitrogen is one of the most important. It is commonly furnished in the form of commercial fertilizers as well as in connection with the various organic fertilizers that are applied to the soil.

Every one knows that a large part of the air is composed of nitrogen, and one might think that an element which is so abundant would be easily available for plant growth. The nitrogen of the air, however, is not in a form which plants can utilize, so that the free-air nitrogen cannot be depended upon for direct help in the growth of flowering plants.



NODULES CONTAINING NITROGEN
On the roots of a leguminous plant.

Fortunately, there are certain low forms of germ life which are able to take the free nitrogen of the air and fix it in a condition in which it can be used by the higher plants. This constitutes a sort of partnership between the bacteria and the various members of the great family of legumes — the clovers, vetches, beans, peas, alfalfa, and related crops. These bacteria produce nodules upon the roots of such plants, and in the nodules the

bacteria multiply and through their life processes gather the free nitrogen of the air. They store it up in the plant tissues so that it becomes available for the growth of the particular plants that they are living upon, and through these it may later become available for the use of other crops. The illustration on page 231 shows the effect of the presence or absence of bacteria in the soil.

This relation between the germs and the leguminous plants is one of the most important factors in maintaining the fertility of the soil. By including in each system of crop rotation one of these leguminous plants, which is to be plowed under in whole or in part, the store both of humus and nitrogen in the soil is increased to a marked degree. For the nitrogen which is gathered from the air is sent to all parts of the plant, so that if the green crop is plowed under, most of the nitrogen remains in the soil to enrich it for other crops.

SOIL TILLAGE AND CROP ROTATION

KINDS OF TILLAGE

Notice in what way the crop-producing soils of your locality are tilled. Observe how the soil is plowed, harrowed, cultivated, rolled, hoed, and raked.

During a dry time in summer notice the cracks that appear in a soil which has been neglected, and compare such a condition with the surface of a soil which has been kept in good condition by tillage.

Learn how deep the fields in your neighborhood are usually plowed. Does the plow go down to the sub-soil?

TILLAGE AND MOISTURE

Notice whether the soil under a board or any mass of rubbish that serves as a surface mulch is more moist than the soil along a path or roadside where there is no mulch and where the surface is not tilled. Do you think that the board or mulch prevents the evaporation of the water in the soil and so holds it for the use of plant roots?

Now find a place in a well-cultivated field where the surface is in a finely pulverized condition and remove an inch or two of the top soil. Is the soil below moist in very much the same way that it is moist beneath the board or mulch? Do you think that this layer of surface soil serves the purpose of a mulch in keeping the water from evaporating?

ROTATION OF CROPS

Find out whether the best farmers in your locality plant their fields to different crops each year. Ask some successful farmer if he ever plants the same field to corn or potatoes for several years in succession.

Learn what crops are used to follow one another by the different farmers in your neighborhood and make a table of as many reasons as you can find for the practice of crop rotation in your vicinity.

Dig up carefully a few plants of timothy, oats, wheat, clover, corn, or other crops and see if you can find how far down into the soil the roots go in each case.

TILLAGE

By tillage is meant some process of digging up and working over the soil. It is the most fundamental practice in the production of the great majority of crops. Unless the soil is tilled at rather frequent intervals, it becomes so firm and hard that it is difficult for plant roots to penetrate it and consequently the plants are unable to thrive.

The two principal kinds of tillage are deep tillage and surface tillage. When we dig up a garden with a spade, or plow a field to a depth of eight or ten inches, we are practicing deep tillage. When we hoe or rake a garden, or cultivate a field, we are practicing surface tillage.

Deep tillage is necessary to furnish a proper place for adequate root growth for most crops. It loosens up the soil particles in such a way that they are easily penetrated by the roots and rootlets and are able to furnish the

tiny root hairs with moisture and materials for growth. The important time for deep tillage is before the crop is planted.

Surface tillage is necessary to keep the upper layer of soil in good condition, to check the growth of weeds, and to prevent the evaporation of soil moisture. The latter result is accomplished because proper surface tillage produces a so-called dust mulch which prevents evaporation from the soil below. The important time for surface tillage is after the crop has started into growth.

CROP ROTATION

The rotation of crops is one of the best ways of conserving the fertility of the soil. When this is practiced one crop follows another in the same field, so that for a series of years no single crop shall be planted for two successive seasons. A common succession is to follow corn with wheat and wheat with clover, so that for a series of three years the field will be planted the first year to corn, the second year to wheat, and the third year to clover, the latter being plowed under after it has been growing one or two seasons, when the field may again be planted to corn. In different regions different systems of rotation are practiced.

There are many advantages in a proper system of crop rotation. One of the most important of these is in the ability to enrich the land by plowing under clover or some other leguminous crop which gathers nitrogen from the air. The principal legumes used in this way are red clover, crimson clover, alfalfa, cow peas, and the vetches. Each of these crops is able to gather free

nitrogen from the air and to fix it so that as the root-stems and leaves decay the nitrogen becomes available for the growth of other crops. There is also thus added to the soil a large amount of green vegetation which helps to form humus, one of the most important elements in the make-up of a soil.

Another advantage of crop rotation is found in the fact that the roots of different plants penetrate to different depths in the soil. Consequently, it is possible to plan a rotation so that each crop will derive most of its food from a different region below the soil surface. Such a grass as timothy is known as a shallow feeder, because its roots generally remain within six inches of the surface. Alfalfa, on the other hand, is a deep feeder, its roots commonly penetrating to a depth of from four to twenty feet. Obviously, there is an advantage in including crops with such different root systems in a rotation.

Another advantage of crop rotation is found in the fact that different plants take different amounts of chemical substances from the soil. While it is not now believed that this fact is of as much importance as was formerly supposed, it still serves as a good reason for practicing an intelligent system of crop rotation.

In most rotations the different crops require very different methods of cultivation. Thus a hoed crop like corn is often followed by a drilled or broadcast crop like wheat. Because of this it is easier to keep in check many sorts of weeds which become unduly abundant when one crop is planted in the same field for many successive seasons. In a somewhat similar way various fungus diseases are checked by rotation, and the injuries of many forms of insect life are prevented.

THE KINDS OF SOILS

LOCAL SOILS

Notice the different kinds of soils which are used for crops in your region. Get samples from a sandy upland soil, a clay soil, a good garden loam, and a swamp soil. Put them into bottles or tumblers and examine their texture through a lens. Add water and shake thoroughly. Notice the differences after the soils settle in the water.

THE KINDS OF SOILS

Soils are classified in many ways, but for our present purpose we may group them simply under these four headings: clay soils, sandy soils, loamy soils, muck soils. Clay soils are composed chiefly of clay, and are liable to cake when wet and to bake when dry. Sandy soils are composed chiefly of sand, the greatest number of particles generally being quartz, and are liable to be unproductive because of a lack of humus and because of their inability to hold water. Loamy soils have a considerable percentage of humus, which makes them easy to work and suitable for plant growth. A given soil may be a sandy loam, having much sand as a basis, or a clay loam, having much clay as a basis. A muck soil is derived mainly from plant growth, and may lack certain elements of fertility necessary to successful crop production.

IMPROVING CLAY SOILS

In many parts of the United States clay soils predominate in a large proportion of the farms. Such soils are likely to be so firmly compacted that crops do not thrive. This is because the particles which make up the soil are in so finely powdered condition that they collect together, prevent the easy growth of roots, retain moisture in wet weather, and bake solid in dry weather. To remedy this condition it is necessary to treat the soil by such methods as will either change its texture or increase the size of the spaces between the soil particles.

One of the most effective ways of improving a clay soil is by a thorough system of drainage. This permits the surplus water to run away rapidly, thus allowing the air freer access from above. It is likely to decrease the injury from surface baking in dry weather, and enables the owner to till the soil oftener and to secure better results by means of such tillage.

Frequent tillage when a clay soil is in a proper condition to work is very helpful in improving its texture. It breaks up the large lumps and greatly increases the amount of air between the soil particles, thus enabling the root hairs to penetrate more freely and the various micro-organisms in the soil to work more effectively.

It is very injurious, however, to plow, spade, or even hoe a clay soil when it is too wet. Such treatment compacts the soil particles so firmly that they harden into solid clumps which plant roots are not able to penetrate. When a clay soil is too dry, tillage can be done only under great disadvantage, as the operation becomes very difficult, and the soil is likely to separate into large lumps which are hard to pulverize.

One of the best ways of improving the quality of a clay soil is to work into it a considerable amount of organic matter. When this decays, the particles of humus become thoroughly mixed with the soil particles, holding them apart and furnishing a porous material that absorbs water readily and also gives it up readily to plant roots. The practice of applying barnyard manures, of plowing under green crops, or of working in fallen leaves is an excellent method of adding organic matter to the soil. By a constant repetition of such practice, clay soils may be brought into admirable condition for crop production.

Clay soils may be greatly improved by the liberal application of some form of agricultural lime. Finely ground limestone appears to be one of the best forms in which to apply this substance. The improvement brought about is to be explained in several ways. Lime has a direct action upon the particles of clay, causing them to break apart and thus increasing the air spaces between the particles. This is often called the flocculating action of lime.

The presence of lime also hastens the decay of organic matter and apparently renders the soil more favorable to the nitrogen-gathering bacteria which live in the roots of clover, alfalfa, and other legumes. The lime neutralizes many acid substances in the soil and directly or indirectly helps to prevent the growth of various organisms which injure the roots of plants.

The application of lime is especially desirable before sowing any leguminous crop. It also helps the growth of many other farm and garden crops, but it has an injurious effect upon potatoes, strawberries, and a few other fruits and vegetables.

IMPROVING SANDY SOILS

In the case of clay soils the particles are too fine for the best results, so that it is necessary to give such treatment as will have the effect of making the particles or the spaces between them larger. In the case of sandy soils, on the other hand, the trouble is quite the reverse. The particles are so large that the spaces between them allow the rapid running away of moisture, and the particles themselves are so hard that they do not absorb moisture, and they afford very little nourishment to the root hairs of plants. In improving such soils it is necessary to treat them so that they will hold water better and will have a larger proportion of organic matter as a basis for plant food.

With most sandy soils the chief method of improvement is to increase the amount of humus by adding large quantities of organic matter and plowing or spading it under. For this purpose barnyard manure, green crops of clover, rye, vetch, or other plants, or the fallen leaves of trees and shrubs serve very well. When any of these materials is mixed with sandy soil, it soon decays and furnishes vast numbers of particles of humus that lie between the particles of sand and help to make the soil more mellow. The supply of moisture and plant food is thus greatly increased, and the opportunity for proper development of plant roots is improved. Such treatment helps to make the soil much more compact.

APPENDIX



SUGGESTIONS FOR THE TEACHER

STARTING SEEDS INDOORS

FOR starting seeds of flowers and vegetables indoors one or more wide shallow boxes is very desirable. It should be of such a depth as to hold readily about three inches of soil and have above the soil surface about an inch of board around the sides so that the water will not overflow. One of the most satisfactory seed beds I have used in school work is one of the familiar sand tables so generally utilized in geography classes. In a great many schools these sand tables are available and may readily be spared for the starting of the seedlings during the few weeks in spring when they are especially needed for this purpose. In the absence of a sand table window boxes or shallow boxes of almost any sort may be utilized.

The seed bed should be placed in such a position that it will get as much light and air as possible, receiving direct sunshine during part of the day. The soil used should be a good rich garden loam which has been sifted through a garden sieve so that all the particles are in a finely pulverized condition. It should be kept moderately moist but not too wet and should never be allowed to dry out completely. The seed may be sown either in drills or broadcast over part of the surface, and should be covered by sifting more soil over it, the depth of covering depending upon the size of the seed.

After the seedlings are up they may be transplanted to shallow boxes, or better to small sized flower-pots. For school use I have found the paper flower-pots to have many advantages over the ordinary pottery kinds. These paper

pots are very inexpensive, the smaller sorts costing at wholesale but twenty-five cents per hundred. They also take up less room than do the common kinds, and as the sides of the pot are of oiled paper they do not allow the constant evaporation that is likely to take place in a heated schoolroom from the entire surface of the ordinary flower-pot. They are less easily broken than the ordinary pot and it is safer to trust pupils to carry their plants home in them.

The seedlings may be grown for several weeks in these individual pots and are then to be transplanted to the outdoor garden. If, in the meanwhile, the roots get too crowded in the pot in which a plant is growing it should of course be repotted into a pot of larger size.

THE FLOWER BORDER

In the case of the more important annual flowers discussed in these pages specific directions are given for transplanting them out of doors. In general it may be said, however, that the best place to plant the flower garden is along the border of a yard, with the fence or wall as background, or along the sides of the house or in some part of the vegetable garden. Flower gardens should not be a bit of space cut in the middle of a lawn, for this not only injures the beauty of the lawn but it seldom gives the flowers a good opportunity to develop.

The first requisite for a successful border garden is a well-prepared place for the roots to live and feed in. In almost any school this is easily accomplished if the teacher will let the pupils help. Dig out the soil or sand or gravel of the site selected to a depth of at least eighteen inches,—two feet is better. Then fill in this lower space with fallen leaves, grass raked from the lawn, mulching from the winter coverings of ornamental gardens, almost anything in fact that consists chiefly of plant fiber that will rot down to form humus. As these materials are placed on the bottom,

sprinkle over a little of the soil taken out so that it is about one third soil. Then on top, get, if possible, eight inches or so of loamy soil. The pupils will be glad to help furnish the latter, if it cannot be obtained otherwise. As the coarse material below rots down it will form a good substance for holding moisture during the dry summer weather.

If there is a long border to be made into a garden, begin at one end and go as far as you can easily the first season, leaving the rest for another year.

The making of such a border garden at school is the best sort of an object lesson to the pupils as to the way the border gardens at home are to be made.

THE VEGETABLE GARDEN

That school is fortunate which is able to provide an outdoor vegetable garden near the schoolhouse for the use of pupils, and these pages should prove a helpful guide in all such cases. But the experience of an increasing number of schools shows that a great deal may be done in the encouragement of home gardens by the pupils, in the numerous cases of those schools which are not so situated that they can have pupils' gardens near at hand.

In most cases it is not desirable to lay too much stress upon the selection of a particular site or soil for the home garden. It is better to encourage pupils to make the most of the soil they have.

The garden is first to be plowed and harrowed, or spaded and raked, to get it in the best possible condition. Fertilizing materials of any sort available should be worked in before or after turning over. Each crop is then to be planted according to the directions given in the text.

RECOGNITION TESTS

Among the projects outlined in the foregoing pages there are many small and temporary exhibits of flowers, fruits and other things, each properly labeled. In order to be sure that such displays have been of greatest benefit it is very desirable to have recognition tests for each pupil.

This exhibit may be placed to advantage in a hallway or small room adjoining the main room. In case such a place is not available have it on a table in a corner of the room. Notify the pupils that after a few days there will be a test to see that each knows the name of every object shown. Then on the day selected remove the labels and give the test to one of the more responsible pupils. Then let that pupil give the test to each other pupil, having them go one at a time and name each object. Mark them on this test, just as you would on a book recitation.

SEED-TESTING APPARATUS

The testing of seeds by individual pupils is one of the simplest and most useful applications of the project method. Such tests can be made in any school at any time with apparatus that any one can get.

In order to germinate a seed needs moisture, air and warmth. Any device that provides these will serve for seed testing. Two pieces of blotting paper kept moist with the seeds between them answers very well. Some more elaborate but very satisfactory devices are shown in the pictures on previous pages.

PLANTS IN THE SCHOOLROOM

It is a very simple matter to have pupils grow plants in the schoolroom with individual care and responsibility, provided one has a few inexpensive zinc trays and a supply of the cheap paper flower-pots to be purchased of any seeds-

man. Have the zinc trays made to fit the window sills or better to fit shelves just below each window. If the windows are wide have two trays for each because short trays are so much easier to handle than long ones. A good size is 30 inches long, 8 inches wide, $1\frac{1}{2}$ inches high.

The paper flower-pots cost from twenty to forty cents a hundred. Good sizes for school work range from the $2\frac{1}{2}$ inch to $3\frac{1}{2}$ inch, the 3 inch size being most generally useful.

A few water-tight zinc window boxes about four inches high and of a length and width to fit the window are also very desirable. A full discussion concerning the making and use of these may be found in *The School Garden Book*.

IDENTIFICATION OF SPECIMENS

The school may have an important influence on community life by encouraging pupils to send specimens of unknown insect enemies or fungous diseases, or of undetermined varieties of fruits, grains or other crops to the State experiment stations or the National Department of Agriculture. These authorities will be glad to identify such specimens and to send any desired information concerning them. The addresses of these institutions are:

Alabama	College Experiment Station .	Auburn
Arizona	Experiment Station	Tucson
Arkansas	Experiment Station	Fayetteville
California	Experiment Station	Berkeley
Colorado	Experiment Station	Fort Collins
Connecticut	State Experiment Station .	New Haven
Connecticut	College Experiment Station .	Storrs
Delaware	Experiment Station	Newark
Florida	Experiment Station	Gainesville
Georgia	Experiment Station	Experiment
Idaho	Experiment Station	Moscow
Illinois	Experiment Station	Urbana
Indiana	Experiment Station	Lafayette
Iowa	Experiment Station	Ames

Kansas	Experiment Station	Manhattan
Kentucky	Experiment Station	Lexington
Louisiana	Experiment Station	Baton Rouge
Maine	Experiment Station	Orono
Maryland	Experiment Station	College Park
Massachusetts	Experiment Station	Amherst
Michigan	Experiment Station	East Lansing
Minnesota	Experiment Station	St. Anthony Park
Mississippi	Experiment Station	Agricultural College
Missouri	Experiment Station	Columbia
Montana	Experiment Station	Bozeman
Nebraska	Experiment Station	Lincoln
Nevada	Experiment Station	Reno
New Hampshire	Experiment Station	Durham
New Jersey	Experiment Station	New Brunswick
New Mexico	Experiment Station	Agricultural College
New York	State Experiment Station	Geneva
New York	Cornell Experiment Station	Ithaca
North Carolina	College Experiment Station	West Raleigh
North Carolina	State Experiment Station	Raleigh
North Dakota	Experiment Station	Agricultural College
Ohio	Experiment Station	Wooster
Oklahoma	Experiment Station	Stillwater
Oregon	Experiment Station	Corvallis
Pennsylvania	Experiment Station	State College
Rhode Island	Experiment Station	Kingston
South Carolina	Experiment Station	Clemson College
South Dakota	Experiment Station	Bookings
Tennessee	Experiment Station	Knoxville
Texas	Experiment Station	College Station
Utah	Experiment Station	Logan
Vermont	Experiment Station	Burlington
Virginia	Experiment Station	Blacksburg
Washington	Experiment Station	Pullman
West Virginia	Experiment Station	Morgantown
Wisconsin	Experiment Station	Madison
Wyoming	Experiment Station	Laramie
United States	Department of Agriculture	Washington, D.C.

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